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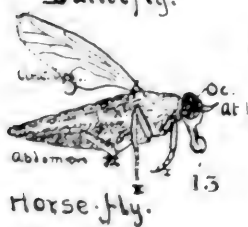
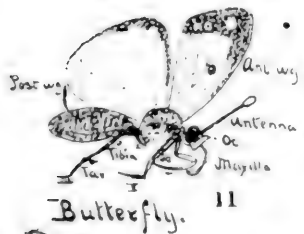
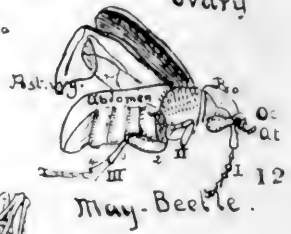
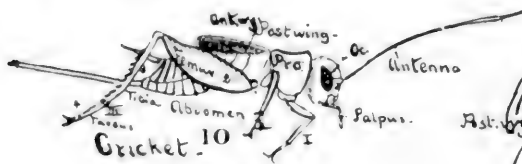
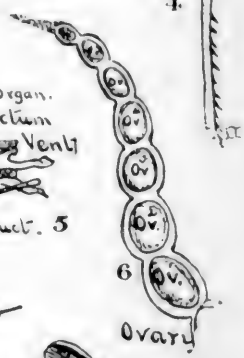
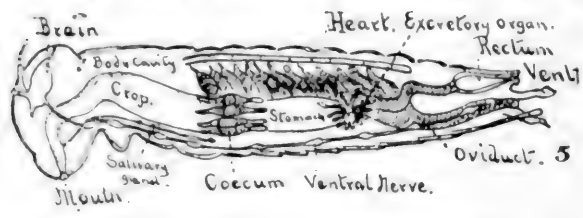
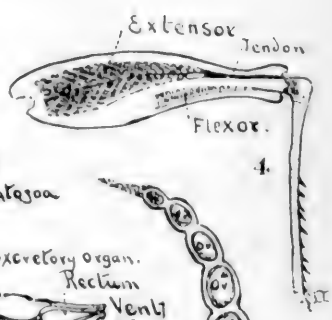
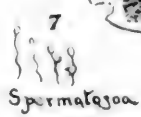
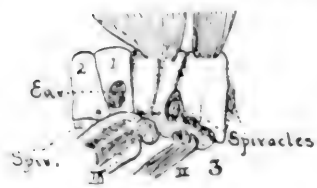
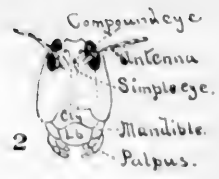
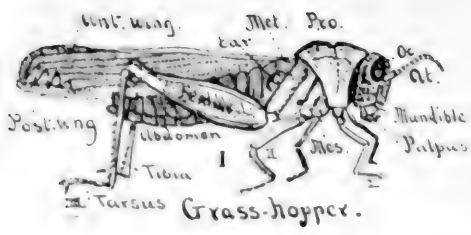
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The Grasshopper, *Ædipoda carolina*; an Introductory Study in Zoology.

BY H. L. OSBORN,

ST. PAUL, MINNESOTA.

(Continued from vol. xiii, p. 282.)

[WITH FRONTISPIECE.]

3. *The respiratory system* in the grasshopper is entirely unlike that familiar to us from a knowledge of the backboneed animal. They breathe by means of gills or lungs. That means that blood is brought by the circulatory vessels to an organ where its gases have access to air, either free, as in a lung, or dissolved in water, as in a gill, and it is also understood that these gases of the blood have come from the organs, and the gases of the air are to be carried to the organs. It is really in the organs that the uses of the gases take place. It would, of course, then be possible to have air conducted direct to the organs which use its gases, and this is the fact in the grasshopper's system. The system consists of surface holes, *spiracles* (Fig. 3), which admit air to main longitudinal pipes, *tracheæ*, from which smaller and smaller branches, which run out into every active portion of the body, carry it to and from the organs. The final air pipes are microscopic, and spread out so as to reach every active portion of the body. The principal gas used by the organs is oxygen, and the principal ones given off from the organs are carbonic acid gas and aqueous vapor. Unless oxygen is constantly carried in, and carbonic acid as constantly carried out by the *tracheæ*, the organs at first become sluggish, and finally dead.

4. *The excretory system* (Fig. 5) is composed of organs whose work is to remove another product which collects in active organs. It is called *urea*. The urea, the carbonic acid gas, and the watery vapor are formed in working organs as a product which results after the chemical union between the oxygen and the substance of the working part. The power of the working part comes from this chemical union, and the part tends to burn out somewhat in the act, like fuel in a furnace,

but, unlike the furnace, an active organ has power to arrest the burning and rebuild itself, provided food is given in time. When the work is done and the products of burning are formed, they must be removed while the gaseous carbonic acid escapes through the respiratory system; the urea being fluid, is taken up by the malpighian tubes and poured into the alimentary tube, whence it escapes with the *feces*. In vertebrate animals the organ for removing urea is called a kidney, and has no connection with the alimentary tube. The alimentary, circulatory, respiratory, and excretory systems of the grasshopper are tributary to the muscular, nervous, and reproductive systems.

5. *The muscular system* is composed of organs called muscles. These are small strips of living substance which have the peculiar property of shortening or *contracting* whenever they are excited or *stimulated* to do so. In the grasshopper they are fastened across joints from bone to bone by tendons in such a way that by contracting and pulling on the tendon the joint can be bent or straightened. The muscles of the hind leg can be easily seen (Fig. 4) by opening the legs and two tendons found so fastened to the tibia that one bends it on the femur and the other straightens it. The same is true for the wings, the mouth-parts, etc., and the walls of the alimentary tube and heart contain the same kind of contractile substance which, by its contraction, causes movement of the substances contained within the tube. The number of separate muscles in a grasshopper's body is very great; by their combined uses in various walls all the exact and beautiful motions of the animal are brought to pass. Thus a jump is produced by the straightening of the femur-tibia joint in both hind legs at once, while walking is due to the conjoint action of all six legs in alternating sets, some going forward while others are going back. The beautiful adjustment of tension at each of the very many joints involved in such an act is regulated in the nervous system.

6. *The nervous system* in the grasshopper is composed of organs called *ganglia* and nerve cords, some of which connect the ganglia into a chain, while others run direct from the ganglia to the various adjacent portions of the body. The principal ganglia of the body form a row or series extending from the head to the tail; the front one or *brain* lies in front of the throat, and sends nerves to the organs of the head, and a pair which pass as a *collar* on either side of the throat and run back to the prothorax. The remaining nerves are on the ventral side of the body, just inside the sterna, and are called the *ventral nerve cord*, and there are one in each thoracic somite and five in the abdomen. The nerve ganglia are the seats from which nerve stimuli are sent out over the nerve fibres or cords which carry the stimuli to the active organs. It is the brain which is the chief seat of nerve action, and also the part whose perfect health and action are necessary to whatever intelligence the grasshopper may possess. That it has some

intelligence we can see very readily ; it is at least endowed with senses of sight, touch, taste, smell, and probably hearing, and can readily judge the distance of a pursuer and take refuge in flight. It may be, in addition, furnished with even higher faculties, though there is less to indicate it in their cases than in the cases of the ants, bees, and wasps, which have a very similar nervous organization. The organs and system thus far considered have reference to the individual life and well-being of the grasshopper ; powers of intelligence and movement enable him to find food and escape capture ; powers of digestion, circulation, etc., keep his body healthy and vigorous, and enable the nervous and muscular actions to take place. But the winter frost kills off innumerable hosts of grasshoppers, to be followed in the following spring by a new brood of progeny, and this action has no reference to the individual, but is a benefit only to the race (of grasshoppers).

7. *The reproductive system* is composed of organs which play their part in producing offspring. They are of two kinds, male and female organs, and borne in separate grasshoppers, which are recognized as male or female by the character of the tip of the abdomen, as described above. The chief organ in the female is the large ovary (Fig. 5), lying above the intestine in the anterior abdominal somites. It is composed of many tubes (Fig. 6), all connected with one final tube, the oviduct. The ovarial tubes contain *ova*, or eggs, in various stages of developement ; the oldest and most mature ones, being nearest the oviduct, pass down it and out into the soil, where they are deposited by the mother. The male specimens, in place of the ovary, have an organ, the *spermmary*, whose tubes communicate with a single out-going duct, the opermatic duct. The spermmary *secretes* or forms a fluid, the spermatic fluid, which contains microscopic, very active bodies of oval shape and furnished with a vibratile thread, whose motion moves the oval body. They are called *spermatozoa* (Fig. 7). When the grasshoppers have mated or paired, a portion of the spermatic fluid is left in the oviduct, and as the eggs descend to be laid they are moistened or *fertilized* by the spermatic fluid. The eggs are deposited in the ground, in cavities made by the tip of the abdomen, and there they develop, and eventually young grasshoppers (Fig. 9) grow from them, which feed, enlarge, acquire wings, and finally in their turn live the life of adults, and finally reproduce their kind and die.

This account of the grasshopper is far from being a complete account of that animal, but it is complete enough to indicate some of the points of view which are taken in the zoological study of an animal. There is a popular study of animals which touches chiefly upon remarkable and striking facts about animals, but is often very superficial and fragmentary ; and there is an economic study which is directed chiefly to the beneficial or injurious aspects of animal life ; but neither of these, as such, is strictly scientific zoölogy, though legitimate enough in their spheres. But

zoological study of animals includes such subjects as have been touched upon in our example of the grasshopper, viz: *Anatomy*, or the construction of animals; *physiology*, or the action of the organs; *embryology*, or the changes gone through by the animal in developing from the egg.

III. SOME OTHER INSECTS.

The scientific study of zoology takes a somewhat thorough study of some animal form as a point of departure toward the study of other animals, and the studies then become comparative. After having become familiar with the grasshopper, it will be of advantage for the student of the subject to compare the grasshopper, at least as far as regards the outward plan and subdivision of the body, with other familiar animals which are similar enough to permit comparisons.

1. **The Cricket** (Fig. 10), *Gryllus abbreviatus*, is an animal which in many respects resembles the grasshopper, and yet does not look very much like one. It lives in grassy, sandy places, beneath dry boards; sometimes it hops short distances, but more commonly runs very rapidly, much faster in fact than a grasshopper can, and it never flies. Its body presents* the same principal and minor external parts. There are three regions: head, thorax, and abdomen. The head, moreover, presents compound eyes, antennæ, and mouth-parts, two lips, and two pairs of side jaws, and furthermore the maxilla has 5-jointed palpus, and the labium a 3-jointed palpus, and the jaws are used for biting. The thorax is divided into a prothorax with pronotum and one pair of legs, and a region behind this bearing two pairs of legs and two pairs of modified wings, anterior ones somewhat as in the grasshopper, and hind wings very small and rudimentary. The abdomen is jointed and tipped posteriorly in the female by extremely long ovipositors. The hind legs of the cricket are much larger than the others, just as in the grasshopper, but they are not used in jumping to any such extent as in the grasshopper.

2. **The May-beetle** (Fig. 12), *Lachnosterna fusca* (see Packard's Entomol. for Beginners, p. 94), is a creature which flies in the evening at dusk in early summer. Its large brown body and awkward movements and buzzing sound, as well as its attraction toward the light, make it a familiar animal to nearly everybody. It looks very unlike a grasshopper or cricket, and yet on close inspection it is found to correspond with them in almost every part of its body; not indeed in the shape of parts, but in the number and relative situation of the parts. The main divisions of the body are head, thorax, and abdomen. The head, furthermore, bears compound eyes, one pair of antennæ, lips and biting jaws, the latter being mandibles, and maxillæ, the maxillæ

*These condensed descriptions should be verified by examination of specimens with drawing.

having, like the lower lip, a pair of jointed palpi. The prothorax is large, separate from the rest, and bears the first pair of legs. The second and third pairs of legs are of about equal size with the first and are borne by somites which are hidden by the hard anterior wings, called *wing covers*. These wing covers are borne on the mesothorax, and beneath them lie membraneous wings, which when not in use are folded back on themselves (Fig. 12) to be tucked away beneath the wing covers. These wings are organs of flight; they arise from the metathorax. The abdomen consists of seven somites and completes the description of the principal portions of the body.

3. **The Cabbage-butterfly**, *Coleas phyllodice* (Fig. 11), can be seen in summer flying in meadows; it can be known by its yellow color with black spots on the wing. An analysis of the points of its general anatomy shows first the head, bearing eyes and antennæ, a mouth with, however, mouth-parts unlike those of the beetle and cricket, no mandibles, hardly any upper and lower lips, and maxillæ having the form of a long coiled tube for sucking nectar from flowers; then the thorax bearing three pairs of legs and two pairs of wings but without any separate prothorax. If, however, the fine scales be removed which cover the thorax lines indicating the junction of three somites to form the thorax can be found, and the wings will then be seen to be attached to the meso and meta portions of the thorax. The wings are not folded and all are used in flight; they are covered with a fine dust which under a lens can be seen to be made of fine scales arranged with the greatest regularity. The legs are jointed and the joints correspond with those of the other insects mentioned; all are of the same size. Finally, behind the thorax is a jointed abdomen which bears no appendages.

4. **The Horse-fly** (*Tabanus exul*) has a body similar in its main divisions and their subdivisions to the bodies of the other animals just considered. The head bears two very large compound eyes, a single pair of very small antennæ, and movable organs surrounding the mouth and used to introduce food into the alimentary tube. There is no separate prothorax, but behind the head a thorax bearing three pairs of jointed legs, and over the middle pair of legs a single pair of wings, the hinder wings being absent in the horse-fly. The abdomen is destitute of limbs and is made up of somites.

5. **The Wasp** (*Polistes metricus**) is another animal whose body upon examination proves to be similar to that of the grasshopper. As points of similarity may be noted the three organs of the body: head, with sense organs (eyes and antennæ, and there are three simple eyes) and mouth-parts; the thorax, bearing three pairs of legs and two pairs of wings; and the abdomen, divided into somites which bear no appendages. Not only are the main divisions of the body similar, but to some extent

* The bee can be used here or a saw-fly.

the lesser parts are as well. The legs consist of a many-jointed distal-position *tarsus* bearing two claws at the tip and of a large tibia and femur, but the femur is joined to the body by a long joint, not a short one as in the grasshopper. The wings, too, are on the meso and meta-thorax, the prothorax being grown to the mesothorax. The mouth-parts, too, present the same parts, viz., lips and mandible and maxillæ, though not like those of the grasshopper in detail.

These comparisons can be extended to the internal anatomy of these specimens, and we find that the organs there located correspond in position and relation with the various systems of the grasshopper; they can be extended beyond the series here taken up to a vast number of other such animals, and in them all the same principles prevail. But it is not possible to demonstrate this plan of body among all animals dwelling together. Thus the spider, slug, saw-bug, and many other animals can be found where crickets live, and yet these bodies cannot be analyzed into such parts as are found in the forms just considered. The spider, for instance, has a body which is divided into two regions; has no compound eyes and four pairs of simple eyes; has no antennæ, no wings, no mouth-parts, no distinct head; has four pairs of legs used for walking, and two pairs of appendages in front which find no compeer among the animals we are studying. Hence the plan we have discovered is a somewhat exclusive one; all animals which possess it we assign to a group we call a *class*, called insects, while we regard the various sorts under the class as *orders*. If we compare the katydid with the other insects we have studied, we shall find it considerably more like the grasshopper and cricket than any others, and these, together with the roach and others, make up the order *Orthoptera*. In the same one we can see that the potato-bug, firefly, pea weevil, lady-bug, and many other very familiar animals are all somewhat like the May-beetle, and belong in a different order from the *Orthoptera*, while ants and bees go with the wasp, and the mosquito and fly belong together. Orders are divided into *families*, and these again into *genera*, and these into *species*. Each of these groups has its name, and in speaking technically of any insect or any other animal we do so by giving the name of the genus and species to which it belongs. The department of zoölogy which is devoted to such comparisons as this is called *systematic zoölogy* or *classification*.

There are still other departments of zoölogical study of which we can here do little more than to mention two which have reference to the distribution of animals over the earth's surface or *geographical distribution* and the date of the appearance of animals in the progress of the geologic history of the earth, or *palæozoölogy*. The genera and species of animals are often rather local in their geographical range. Northern Europe and North America both have the same genera of grasshoppers, but have few if any of the same species, while some families, on the other

hand, are wholly northern and others are wholly southern. Of the various orders of insects the grasshoppers and their like were among the first to appear, but the earliest insects are by no means the earliest class of animals; in fact, most of the other classes, except the higher vertebrates, had been in existence many ages before any insects appeared, the earliest insect remains being carboniferous.

COLLATERAL READING.

- Brooks. Invertebrate Zoölogy, p. 237.
 Howes. Atlas of Biology.
 Huxley. Anatomy of Invertebrata, p. 342.
 McLauchlan. Insects. Encyc. Britt., XIII, p. 141.
 McLauchlan. Locust. Encyc. Britt., XIV, p. 765.
 Osborn. Invertebrate Dissections, p. 33.
 Packard. Zoölogy, p. 307.
 Packard. Entomology for Beginners.
 Packard. Guide to the Study of Insects.

A very little observation will suffice to show any one that grasshoppers are not all alike, and that there are many animals not truly grasshoppers which are still much like them, as the katydid and cricket, and others which are like them in a more general way as insects. In other words, there are degrees of resemblance.

EXPLANATION OF THE PLATE.

- | | |
|---|--|
| 1. Right side view of adult grasshopper (<i>Edipoda carolina</i>), right wings removed.
2. Front view of head of the same.
3. Enlarged side view of meso-meta-thorax to show the spiracles; the origin of the wings and legs and the ear.
4. View of the interior of metathoracic femur, showing the large extensor and smaller flexor muscles and their tendons.
5. Diagram of the internal anatomy of a grasshopper.
6. One ovarian tube and contained ova (x 30 diam.)
7. Spermatozoa. | 8. Mouth-parts of (<i>Edipoda carolina</i>), from nature.
9. Larva of grasshopper, wings not yet developed.
10. Side view of cricket (<i>Gryllus abbreviatus</i>), right wings removed, showing rudimentary posterior wing and large anterior wing cover.
11. Cabbage-butterfly (<i>Coleas phyllodice</i>), right wings removed.
12. May-beetle (<i>Lachnosterna fusca</i>), right wings removed, showing left wing cover and hind wing half folded.
13. Horse-fly (<i>Tabanus exul</i>), right side, right wing removed.
14. Wasp (<i>Polistes metricus</i>). |
|---|--|

All the drawings are taken directly from nature, except 5 and 9, which are adapted after Pepakra.

Detection of Crime, Murder.—A murderer, on whose axe marks of blood had been found, stated that he had killed a goat with it shortly before his arrest. As a matter of fact, human blood corpuscles were found on the axe. It was proved by means of authentic goat's blood that had been photographed for comparison with photographs of human blood that the axe was not stained with goat's blood.

By photography it was also shown that the axe had been wiped after the deed, a fact which the accused denied. The magnified image revealed streaks caused by wiping from top to bottom and small spots that could not be seen with the naked eye.

The Tariff on Microscopes and Accessories.

By CHAS. W. SMILEY,

WASHINGTON, D. C.

The tariff law now in force was approved October 1, 1890, and went into force six days later. It was entitled "An act to *reduce* the revenue and equalize duties on imports." The way in which it sought to reduce the revenue was by putting duties upon many articles at so high a rate that no one would buy foreign goods. In this way many articles that had formerly furnished a revenue would practically cease to do so. With a duty fixed at 50 or 60 per cent. ad valorem, revenue is impossible.

The part of the law applicable to microscopes and accessories reads as follows: "Manufactures, articles, or wares not specially enumerated or provided for in this act, composed wholly or in part of iron, steel, lead, copper, nickel, pewter, zinc, gold, silver, platinum, aluminum, or any other metal, and whether partly or wholly manufactured, forty-five (45) per cent. ad valorem."

On lenses, however, there is a duty of 60 per cent. ad valorem. On razor blades, which are of use to microscopists, there is a duty of \$1.75 per dozen, to which must be added another duty of 30 per cent. ad valorem—*two duties on one article*.

Of course the above duties are high enough to practically prohibit importations and to give the market to home manufacturers.

But another thing must be remembered. Nearly all the raw materials which our manufacturers use in making our instruments are likewise covered by duties designed in the same way to greatly enhance their value. Thus the duty on nickel is 10 cents per pound; on brass, $1\frac{1}{2}$ cents per pound; castings of malleable iron, $1\frac{3}{4}$ cents per pound; sheets of iron or steel, if polished, $2\frac{1}{2}$ cents per pound; bronze powder, 12 cents per pound; varnish, 35 per cent. ad valorem. Not only are the values of most articles entering into the manufacture of microscopes and accessories increased by tariff laws, but our microscope manufacturers have to pay for their machinery, for their coal, oils, chemicals, etc., prices higher than they naturally would be. The protective duties prevent them as well as us from buying in the cheapest market, and the goods must sell at enough higher prices to cover the difference.

Having thus endeavored to state the law without prejudice and without argument, it remains to set forth the sentiments of our workers and microscopists regarding it. Among other questions, we have asked this of them: "Are you in favor of or opposed to the present tariff on slides and instruments?"

From about 500 returns, all being by persons actually owning instruments and engaged in microscopy, the facts have been compiled as follows:

Number in favor of the tariff	82
Number opposed to the tariff	323
Number declining to reply to this question, though answering others	90
Total	495

Another bearing of the law upon microscopy is in relation to books, pamphlets, maps, charts, photographs, etc., which relate to this subject and which students desire. Upon all these books etc., whether bound or unbound, there is a duty of 25 per cent. ad valorem if published in the English language and not over 20 years old. Books for colleges, societies, etc., are, by exception, admitted free.

Regarding this question of tariff upon books, no opinions have yet been obtained from our microscopists, but such as choose to write are invited to do so for citation in a future article.

IN FAVOR OF THE TARIFF.

Among the affirmative replies are some of especial interest, the phraseology being unique. The following are perhaps worth quoting verbatim :

I am in favor of a tariff, even to the prohibition of such imports.—A. F.

In favor of it as it stands.—J. E. D.

Yes ; will vote every time for tariff.—C. E. J.

In favor of tariff for everything else and must be consistent.—Mc. K.

Don't like to pay it, but want our manufacturers protected.—A. C. G.

I am a Democrat, but cannot go free trade. I am a protectionist.—H. M. D.

I favor tariff on anything that can be produced in this country, including microscopes and objectives.—C. S. F.

In favor of a tariff to encourage home makers.—W. R. L.

It is well to protect our home industries.—R. E. W.

Protection to home industry.—W. E. C.

In favor of protecting American industries.—G. E. F.

Protect home industry.—W. E. B.

Protection for American industries.—H. S.

Protection to all American industries.—S. H. D.

I favor protection of home industries.—R. F. B.

I believe in home protection.—J. S. H.

I believe in protection.—G. D.

In favor of the tariff. Am a Republican.—E. F. B.

In favor. Let us be somewhat self-reliant.—J. A. T.

In favor so long as slides for private collections are admitted free.—J. E. B.

I am decidedly in favor of tariff. It has brought manufactures to our door.—F. O. Y.

I am a protectionist. Don't think we need fear foreign goods—prefer American.—T. D. G.

I think some American microscopes as good as foreign. I am a protectionist.—C. M.

I favor it. America is "in it" with any country across the water.—H. G. G.

Protect American industries every time. If our manufacturers are not up to foreign makers, let them hurry up!—J. G. D.

See no reason why slides or instruments should come in free, considering the excellence of those made by our best makers in what is yet an infant industry.—H. H.

Yes, when it brings American brasswork up to the continental standard; otherwise, No.—J. D. K.

I favor a tariff just sufficient to protect wage-workers engaged in manufacturing optical goods.—G. A. L.

I have not studied the question. Believe in protective tariff in general.—G. G. D.

Not posted on the question, but should think yes.—A. E. H.

I am in favor of a tariff on slides but not on instruments. It is absolutely wrong to have high tariff on brass, etc., and not on finished work.—P. T.

I am in favor of tariff on instruments, opposed to it on slides.—T. B. R.

I favor tariff on instruments. Slides might come in free.—G. C. F. H.

In addition to the above (33), we have received 49 replies in which the writers simply answer affirmatively, making a total of 82 in favor of the present tariff.

OPPOSED TO THE TARIFF.

The following interesting statements of position on the question are likewise in the writers' own words:

Opposed to ALL tariffs.—H. M. F.

Opposed always.—G. M. S.

Opposed all the time.—C. E. B.

Opposed to any tariff.—C. C. H.

Opposed to all tariff in general.—H. S.

Opposed to protective tariff of any kind.—W. B. S.

Very much opposed to it.—H. B. W.

Opposed first, last, and for all time.—G. W. P.

Decidedly opposed to it.—D. F.

Opposed to all tariff.—E. N. B.

Opposed heartily.—J. E.

Unmitigatedly opposed.—W. N. B.

Am flatly opposed to the tariff.—F. L. S.

Opposed decidedly.—E. H.

Opposed to all tariffs on all things; an out and out free trader.
—W. C. W.

Strongly opposed to the tariff.—O. E. P.

Strongly opposed.—E. M. C.

Strongly opposed.—C. W. S.

Strongly opposed.—F. K. S.

Decidedly opposed.—S. E. S.

Decidedly opposed.—G. F. E.

Decidedly opposed. E. W. A.

Decidedly opposed.—G. C. P.

Decidedly opposed.—W. E. M.

Very emphatically opposed to it.—G. E. S.

Opposed to high tariff.—J. E. B.

Opposed to tariff of any sort.—G. S. C.

Against the tariff.—S. J. P.

Opposed all the time.—E. N. S.

Eternally opposed.—W. J. M.

Personally, would prefer no tariff.—J. W. L.

I favor free trade.—M. D. E.

Free trade.—W. L.

I am a free trader (you bet).—J. E. H.

A free trader in everything.—H. C. W.

A free-trader Democrat.—G. S. L.

Opposed to all tariff—free trader.—P. O. R.

I am a free trader, and especially in this matter.—A. M. K.

Am a free trader out and out.—C. A.

Against. Am a free trader.—A. S. N.

I am free trader.—G. H. B.

Am a bigoted free trader.—N. H. J.

I am an absolute free trader, consequently opposed to all tariffs.—E. P. W.

Am opposed to it. Am a Democrat from way back.—E. L. F.

Most emphatically opposed.—M. H. A.

Away with tariff.—G. N. A.

Want free trade in Micro. goods.—N. A. S.

Opposed to present or any tariff.—M. B. H. D.

Favor free trade in all commerce.—J. M. L.

Am opposed to tariff on almost anything.—J. M. B.

Think they should be imported, duty free.—M. N. V.

Am opposed to all protective tariffs. Do not see why microscopes should be singled out from free trade.—L. D.

Opposed to a tariff or tax on anything produced by human labor.—J. B.

Decidedly opposed to a war tax on all necessities of life.—D. C. L.

Opposed to it. It is a very mean law. We make no money out of it.—H. G.

Opposed to all tariff except for revenue.—H. F.

Opposed to all tariff except for revenue.—O. P. P.

I am for absolute free trade on everything, except for revenue.—J. R. B.

From an economical standpoint, I am opposed to the tariff.—A. G. Y.

Am a Democrat and consequently opposed to tariff, or very much of it.—G. R.

Think it should be less, or possibly removed.—H. S. B.

Present tariff is too high.—N. W. C.

Am in favor of a moderate tariff only.—G. H. H.

Moderate tariff only should be imposed.—A. E. S.

Opposed. Reduce the surplus. I use and believe in American instruments, however.—A. A. W.

In general I am a protectionist, but I think that the duties should be reduced.—A. P. C.

Am opposed to it. I include also scientific books, etc.—T. G. L.

Opposed. I want an Abbe camera and a few other foreign instruments.—E. P.

I do not think the tariff is burdensome, though a reduction could be made whereby some would be benefited.—A. S. E.

Opposed to tariff on instruments, providing home trade could be encouraged also.—M. S. P.

Have not studied the subject, but at present I am opposed.—E. W. D.

Not posted as to this item, but opposed to tariff on general principles.—J. A. S.

Suppose I ought to be in favor, but I would be glad to have prices lower.—A. A. Y.

Not in favor (for my own interest).—I. P. B.

Would make it all tariff or all free.—J. I. H.

I would like to see it "off," so English instruments and slides can compete with ours.—A. B. N.

Opposed, for American genius can always compete with foreign labor.—J. R. P.

I hold the Massachusetts tariff reform views.—B. F. D.

Opposed to any tariff. It keeps up prices here and taxes the consumer for the benefit of a few dealers.—E. G. H.

Think our makers could get along without the tariff and do a much larger trade, as the lessened price would induce more people to buy.—L. H. N.

On principle in favor; for personal reasons opposed.—H. P. H.

Tariff on material produced of excellence in the country. No tariff on instruments not produced here.—F. N. P.

In general am opposed to the tariff on instruments.—A. B.

I should prefer to see them free.—J. M. G.

Opposed to the present tariff on slides.—F. R. J.

Not on slides, but on instruments.—S. A. J.

Opposed on slides.—C. G. M.

Opposed to tariff on slides; not certain on instruments.—F. S. M.

Not free for instruments, but free for slides. —W. C. W.

The tariff on slides for personal use no longer exists. I am opposed to a tariff on instruments. —W. R. M.

I am opposed to tariff on slides; care nothing for that on instruments; would never buy anything made out of the United States if I could help it. —H. F. S.

I am opposed to tariff on instruments, and particularly on slides. —M. C.

Opposed to any tariff on slides, but not so for instruments. I consider slides mostly as specimens. —V. J. H.

I am decidedly opposed to tariff on microscopical instruments and telescopic. —R. P. D.

Decidedly opposed. It is practically a fine (60%) placed on those who love to investigate. —R. E. S.

I am a protectionist, yet I believe it is to the interest of microscopic science to import instruments and accessories free of duty. —C. H. E.

Scientific apparatus free of duty. —G. G. D.

Opposed to every tax upon education. —A. B. H.

Opposed to tariff on all scientific work. —T. S. C.

Opposed on educational grounds, though not a free trader generally. —R. H. W.

Draw the line in favor of science, not of the pocket-book. —W. A. N.

Opposed to any restriction being placed on scientific research. —O. C.

I am strongly in favor of a free exchange of all articles of scientific value, though I am a Republican and believe in protection to some extent. —B. F. M.

Am not sufficiently posted to answer positively, but am inclined to favor no tariff on slides and instruments. We don't need any. Our instruments to-day are superior to the foreign instruments. —W. N. S.

Anything that interferes with microscopical studies in America I think is wrong. —J. C. H.

As I understand it, I would take off the tariff on all scientific instruments. —A. M. E.

I am strongly opposed to the tariff, as it results in limiting education. —G. E. A.

Opposed to all taxes on scientific instruments and goods. They are dear enough without taxes. —V. A. L.

I am in favor of removal of all restrictions and in favor of every advantage to free scientific intercourse. —J. A. M.

Opposed to it? Most decidedly I am. It is a villainous tax on science. —A. J. W.

Am opposed to tariff on all educational necessities. —F. A. B.

No; nor of a tariff on any similar objects, or on works of art or of intellectual culture. —F. W. T.

As a student I am opposed to tariff, but I decidedly prefer American instruments and objectives. —S. G. S.

Am opposed to any tariff, "for revenue only," or for any other purpose, on scientific books or instruments.—D. J. B.

Opposed; so of all articles relative to the sciences.—E. F.

Opposed to any tariff on scientific or educational apparatus or supplies.—S. D. B.

I am decidedly opposed to all taxes on scientific investigation or on articles needed in gaining a scientific or other education.—A. G. Y.

I am opposed to the present tariff, as I think that all instruments for scientific study should have but a small duty imposed upon them.—H. C. B.

To the above list of 118 names should be added 205 names of correspondents who answered with a simple negative, making 323 votes against the present tariff.

Let it should be suspected that the "Solid South" has considerably influenced this vote, we give the geographical distribution of the 323 negative answers, which is as follows:

6 New England States (of which 23 are in Mass.).....	41
4 Middle States (of which 65 are N. Y. and 22 Pa.).....	90
9 Western States (Ohio 20, Ind. 8, Ill. 29, Mich. 18, Wis.	
5, Minn. 7, Iowa 8, Kans. 15, Nebr. 5).....	115
3 Pacific States (of which Cal. 14).....	18
District of Columbia and Territories (of which D. C. 6).....	11
14 Southern States (of which Mo. 17).....	48

323

From the above it will be seen that New York, Pennsylvania, Massachusetts, Ohio, and Illinois have furnished 159 votes, or about half of all. There are very few microscopists in the Southern States.

Staining Fibrin.—M. Sabouraud communicates in the *Annales Inst. Pasteur*, 1892, p. 184, a method for staining fibrin which is said to be superior to that of Weigert. Pieces of chancre fixed in Müller's fluid are placed for 15–20 hours in the following solution: Tannin 1-200, alcohol 10 ccm. to 200 of the solution; they are then stained with anilin-violet (Ehrlich) and then colored by the Gram-Weigert method, in which during decoloration clove oil is substituted for analin oil.

Kangaroos in Australia.—On one ranch of 70,000 acres 10,000 kangaroos were killed annually for 6 consecutive years. There are estimated to be four million of these animals in New South Wales. The government pays 16 cents per head for them. Skins are exported to England and America to be used for leather.

Microscopy at the World's Fair.

By HENRY L. TOLMAN,

CHICAGO, ILL.

Address before the Microscopical Section of the Chicago Academy of Sciences.

About eighteen months ago the Illinois State Microscopical Society decided to make a representation at the coming Columbian Exposition, and appointed a committee of three, consisting of Dr. L. D. McIntosh, Mr. C. O. Boring, and myself, to solicit exhibits. On the death of Dr. McIntosh, Mr. W. H. Summers was appointed in his place. The design of the society was to take the requisite space at the World's Fair and then ask all the microscope makers in Europe and the United States to make a display of their productions, and also, if possible, to get exhibits of mounted slides, &c., from various workers in different departments of science. I spent last summer in Europe, and as chairman of this committee and also as member of a similar committee appointed by the American Microscopical Society, I visited all the leading European microscope makers, with one or two exceptions, and was very much pleased to see the interest they took in the matter. Several said they would rather make an exhibit in such a scientific display than in the commercial department, and it is probable that nearly all will be represented. In fact, it is safe to say that the exhibit of modern instruments and accessories will be the most extensive that has ever been made at any World's Fair.

In regard to a display of old instruments, unfortunately nothing could be accomplished. There are only three large private collections of microscopes in Europe. By far the largest and finest not only in England but in the world is that of Mr. Frank Crisp, a prominent and wealthy London solicitor. It contains over 2,000 microscopes, besides a very large number of substage attachments, condensers, microspectroscopes, live cages, mechanical stages, polariscopes, objectives, and other accessories, which give an accurate history of the microscope and its development. An evening spent with Mr. Crisp and his collection is one long to be remembered. Many of these instruments are very fragile and complex, not a few are unique, and it would be impossible, without great time and expense, to box and ship them anywhere. Some, on account of their fragility and complexity, could not be transported at all, and hence Mr. Crisp said he felt compelled to decline even to attempt to send his collection to Chicago. The next largest collection is that of Mr. Nachet, the well-known Paris microscope maker, and it also contains some beautiful and rare instruments. Among others, he has a unique specimen of the first known binocular telescope and an unexampled collection of simple microscopes in gold or silver engraved cases. Dr. H. Van Heurck, of Brussels, one of the most able and enthusiastic microscopists living,

has also a fine selection of old instruments, but both of them, like Mr. Crisp, were unwilling to allow their treasures to be subjected to the dangers of a long journey. The society will therefore be compelled to fall back on the collection in the Army Medical Museum at Washington, which, it is hoped, the Government authorities will bring here for exhibition.

The exhibit of the society ought to be of a good deal of interest, for in some senses it may be said that microscopy has reached its acme. Prof. Abbe says that it is not probable that any glass will be discovered of higher refractive index than that known, and without that it is not possible to construct lenses of much higher power or angle than at present. Our present objectives, then, are nearly perfected, unless future investigations show our theory of light to be erroneous. In regard to microscope stands, there are a large number of forms for different purposes, many very attractive. Klonne & Mueller, of Berlin, manufacture one of the Zeiss form wholly of aluminum, except the foot. Those who will exhibit, so far as they have already consented, are Baker, Swift, Crouch, Beck & Beck, and Powell of London, Klonne & Mueller of Berlin, Zeiss of Jena, Hartnack of Potsdam, Reichert of Vienna, and probably Nachet of Paris, and Leitz of Wetzlar.

One of the pleasant features of the exhibit will be that, by express permission of the manufacturers, the committee of the society will be allowed to show the various stands and objectives at the meetings of the society or at such times and places as may be agreed on, so that all microscopists will have an opportunity of seeing the best foreign work, and comparing it with that done in this country. The domestic manufacturers will not be behind in their display, and they have already taken the necessary steps to be seen. Dr. E. Cutler, of New York city, has consented to allow his famous Tolles 1-75 to be exhibited. The space assigned to the society by Prof. Peabody, the chief of the department of Liberal Arts, is in the south gallery of the Liberal Arts building, next to the astronomical and photographic exhibits, and close to the commercial displays of Bausch & Lomb, Queen & Co., Zeiss, and others, and is in a very advantageous part of the building.

Mosquitoes.—Petroleum has been found advantageous in preventing the breeding of these insects. Four ounces in a pond 60 feet in area cleared it for 10 days. Creosote or any oil would have the same effect probably.

Mr. Howard, of the Agricultural Department, experimented with kerosene upon a small area and killed 370 females. In 20 days these might have produced 74,000 young (200 each). It is believed that this simple process of oiling the water of bogs and ponds where they breed will greatly increase the value of lands and of summer hotels near infested places.

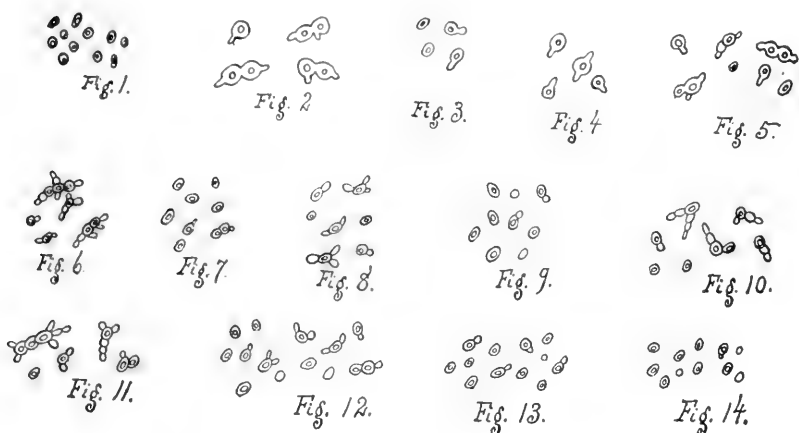
Experiments with Yeast—A Biological Study.

By J. W. SMITH,

ST. PAUL, MINN.

A small bit of yeast from a cake of compressed yeast, suspended in a drop of water on the glass slide of the microscope and examined under the low-power glass, was found to be uniform in composition. The high power revealed the form of the minute globules of which it was composed. These globules are unicellular, consisting of protoplasm contained in a cell wall. No nucleus was visible, but a vacuole was plainly seen. (Fig. 1.) This was the appearance of the mass.

For the study of the nutrition of yeast, Pasteur's fluid was the basis of the experiments. Yeast in the solution 24 hours at the



temperature of the laboratory, was found to have grown by budding into such forms as those shown in Fig. 2.

Experiment 1—*a*. In water 5 hours, at the same temperature, none were found to have more than one bud, and many none. (Fig. 3.)

Exp. 1—*b*. In 80 parts water and 15 parts sugar, under the same conditions, most of the cells were budded with a single bud. (Fig. 4.)

Exp. 1—*c*. In all the ingredients of Pasteur's fluid but sugar a few of the cells were budded, but not so many as in the former experiment.

Exp. 1—*d*. In Pasteur's fluid 6 hours, 20° C., the parent cell was budded at each end, and in many cases the bud was budded. (Fig. 5.)

The second series of experiments was also to test the food value of various mixtures, but for a longer period of time, 27 hours in light at 18° C.

Exp. 2—*a*. Yeast in Pasteur's fluid was well developed, as many as nine cells being found in one colony. (Fig. 6.)

Exp. 2—*b*. In Pasteur's fluid without sugar, for the most part undeveloped, some with one or even two buds. (Fig. 7.)

Exp. 2—*c*. In water and sugar as many as four cells in one colony, though some were not budded at all. (Fig. 8.)

Exp. 2—*d*. In water, very few were found to be budded at all, though some had a single bud. (Fig. 9.)

The third series of experiments was for the purpose of determining the effect of light and heat. All in Pasteur's fluid.

Exp. 3—*a*. In laboratory, 24 hours in light, about 18° C., the yeast had grown well, as high as six cells being found in one colony. (Fig. 10.)

Exp. 3—*b*. In Ladies' Hall, 24 hours in light, probably about the same temperature, scarcely any difference was to be seen from above, though none quite so highly developed.

Exp. 3—*c*. In Ladies' Hall, same conditions as above, except in the dark, was fully as well developed.

Exp. 3—*d*. In oven 4 hours at 40° C., without light, the cells had not budded so well; some, however, having two buds.

Exp. 3—*e*. In light, at 0° C., very few cells were budded, and those had only a single bud.

The fourth series of experiments were with a view to establishing the injuriousness of certain ingredients, as mercuric chloride, and it was added in different quantities. Pasteur's fluid was used; time, 22 hours; temperature, 18° C.

Exp. 4—*a*. In Pasteur's fluid with no mercuric chloride, as high as nine cells together. (Fig. 11.)

Exp. 4—*b*. In Pasteur with 1 : 10,000 HgCl_2 , a number of cells had two buds, while most were undeveloped. (Fig. 12.)

Exp. 4—*c*. With 1 : 1000 of HgCl_2 , a small number of cells had a single bud. (Fig. 13.)

Exp. 4—*d*. With 1 : 100 of HgCl_2 , scarcely a budded cell was to be seen. (Fig. 14.)

From these experiments we conclude that the method of reproduction is by a system of budding; that light is not essential, and that the most favorable temperature is considerably above 0° and below 40° C; also that certain chemical substances are favorable, while others are deleterious to growth.

BIOLOGICAL LABORATORY.

HAMLIN UNIVERSITY, *Dec. 18, 1892.*

Arranged Butterfly Scales.—When we were in Paris, last summer, Mr. George Clifford, who is a microscopist and one of the most genial Englishmen in that city, presented us with a slide representing a rooster, a hen, and five chickens, made by arranging butterfly scales. The slide is the work of Mr. H. Dalton, of Paris, and has already occasioned much admiration in Washington.—*C. W. S.*

EDITORIAL.

Microscopy an Art.—In a recent number of the *American Naturalist* the editors say: "Microscopy, which is an art," etc. Curiously, however, this same periodical, which is devoted to the natural sciences, presents its general notes under seven heads, as follows: "Geology, mineralogy, botany, zoölogy, embryology, entomology, and microscopy." About the first six subjects being sciences there is no question raised, but the seventh is added just as if it were also a science, when its editors say, editorially, that microscopy is an art. Why does a scientific periodical have a department devoted to one of the arts, and why employ a scientist to edit that department?

Scientific Societies of Washington.—The "Joint Commission of Six Scientific Societies of Washington" is preparing a Joint Directory for 1893. The Microscopical Society of Washington is still excluded from the list, which now consists of the Anthropological, Biological, Chemical, Entomological, Geographic, and Philosophical Societies. Is geography a science? Is philosophy a science? Or are these societies admitted because of the scientific methods employed by them in promoting geography and philosophy? Is it not time for the Microscopical Society to find out whether or not it belongs in the list of scientific societies?

PROBLEMS.

NOTE.—*Topics are suggested occasionally upon which a variety of views would be desirable. The problems will be stated under this heading as they arise, and persons having facts or opinions pertinent thereto are invited to transmit the same, which will be published under the heading, "Letters to the Editor."*

1. **Dry Objectives.**—A person who wishes to examine diatoms and other very minute objects is in doubt whether to buy a dry objective (say 1-6, 1-8) or a homogeneous immersion objective (say 1-10, 1-12), because he has heard that dry objectives lack definition or resolution.—E. F. B.

2. **Urinary Salts.**—In evaporating a drop of urine and examining it with polarized light, several crystals appeared, some being dumb-bell shaped and other stellate in form. What were they and how can they be separated and mounted permanently?—E. M.

3. **Micro-spectroscope.**—An easily-made form of spectro-scope which can be attached to an ordinary microscope would be a convenience.—W. S.

LETTERS TO THE EDITOR.

NOTE. — *This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.*

(1) **Dry Objectives.** In problem No. 1 is propounded a rather hard question (p. 19). In attempting to answer it several considerations suggest themselves.

For the examination of diatoms, without attempting to go into their minutest study, a fine dry 1-6 or 1-8 (say such, for instance, as the Reichert No. 7a) would be found most generally suitable, and would be more convenient than an immersion lens. Such a lens will also do good work in the examination of bacteria, bacilli, etc.

But for the most thorough study of diatoms, their finest markings, and the minutest bacilli, micrococci, etc., a first-class oil-immersion 1-12 inch objective should be used. Such an objective is undoubtedly greatly superior to a dry lens in resolving power and in the clear showing of minutest structure. A dry objective is more quickly and easily used, but there is nothing really difficult in the use of an oil-immersion lens, if properly used. A common fault is to use too much oil. A very little only is necessary, and the use of the oil in small quantities is conducive to neatness and cleanliness.

EDWARD PENNOCK.

QUEEN & CO., PHILA., Jan. 19, 1893.

(2) **Dry Objectives.**—I think all agree that the best images are given by the homogeneous objectives. They serve me the best.

S. H. GAGE.

CORNELL UNIVERSITY.

(3) **Dry Objectives.**—Replying to your query, would say that the definition and resolution of any dry working objective is not lacking to the limit of capacity as given under N. A. for each objective. A dry objective is always preferable, as it is less bothersome, but its capacity (angle or aperture) is limited. It very frequently occurs, particularly in the resolution of different diatom tests, that nothing less than the best of high-power immersion objectives must be used.

BAUSCH & LOMB OPT. CO.

ROCHESTER, N. Y., Jan. 20, 1893.

(4) **Dry Objectives.**—Both classes of objectives have their uses. For rapid work over tolerably familiar objects, a dry objective is indispensable. A good 1-6 inch of 140° will do much excellent work. Mounts, temporary or permanent, may be quickly

and safely examined, and there is no immersion fluid to be cleaned away from lens or cover-glass. The moderate angle allows a certain amount of penetration (thickness of focal plane), which enables one to perceive quickly the inter-relation of cells or other structures, and such an objective is comparatively easy to handle in every way. The unavoidable loss of light between the cover-glass and front line of a dry objective materially reduces definition, *i. e.*, resolution, and this considerably offsets the convenience attending its use and bars it out for critical work over the more minute objects.

An immersion objective, utilizing more light than a dry one, presents a sharper and more brilliant image. A water immersion objective of but 89° angle will transmit as much light as a dry one of 140° . A good hom. imm. objective of 1.40 N. A. will transmit nearly two and a half times more light than either. The study of minute objects, like diatoms, the flagellæ and spores of bacilli, very delicate membranes etc., requires the use of the highest grade of immersion objectives. Diatoms, generally, are symmetrical, colorless, and flat; their markings are regular and have comparatively sharp outlines, and their resolution is assisted by the contrast of the shadows produced by oblique light. Slight degrees of aberration in the correction of the objectives may be detected by the color or distortion of the image. Perfect adjustment by means of the collar can be rather easily made, and the full powers of a good objective brought into use over these objects. In histological work the conditions are different, and it is a more troublesome matter to acquire the ability to correct a fine objective. Histological elements are of various sizes and shapes; they lie in all planes and directions. They are usually highly colored (stained), and are, as a rule, examined with the light central. The art of correcting a high-grade objective so as to secure its best performance for this work means the mastery of a Möller test-plate with oblique light, and then a post-graduate course on the same plate, until its No. 18 can be resolved with central light. After this practice, work over histological elements can be intelligently undertaken. In skilled hands a hom. imm. objective presents images so satisfying that one would never willingly go back to the use of inferior lenses for any kind of work. Histological sections or teasings are of appreciable thickness, and a glass with a fair working distance is a necessity. This in many cases precludes the use of objectives of the highest angle, with their necessarily very short working distance. The writer has a 1-10 inch of 1.32 N. A. which can be used over the average mounted section, and it is very satisfactory for work over a wide range of objects. Such a lens has but a small amount of penetration, and the higher angle, 1.40 N. A., has still less; but frequent and slight changes of focus compensates for this to the practised eye. S. G. SHANKS, M. D.

ALBANY, N. Y., Jan. 22, 1893.

MICROSCOPICAL APPARATUS.

An Excellent Mounting Medium.—Dissolve gum damar in benzol to the consistency of a thin syrup. Get rid of the larger particles of dirt by straining through an old silk handkerchief, and add to the colate about one-third of its volume of liquor potassæ. Shake until mixed, cork well, and set aside in a warm place for several weeks. On examination the mixture will be found to have separated into two layers, the lower of which (a resin soap) will contain all the impurities, the upper consisting of pure neutral damar in benzol. Draw this off and to each ounce add about 8 or 10 drops of poppy oil. This latter prevents the brittleness which the dry damar naturally possesses. The mounting medium thus prepared is too thin for immediate use, but this is easily remedied by leaving the bottle open or loosely corked in a warm place for a day or two. If left open, cover the top of the vessel with a bit of lint cotton or a linen rag to keep out dust.—*National Druggist, December 1, 1892.*

A Nearly Colorless Damar.—Dissolve the damar in benzol and make sufficiently thin to filter readily through paper in a closed filter. Filtration may be avoided, if you have plenty of time, by adding zinc oxide, shaking well, and allowing to stand until the oxide settles to the bottom, carrying all foreign matters with it. The oxide should be wet with benzol before adding it, to insure its thorough incorporation. Filter or decant, as the case may be, and to the filtrate add alcohol in small quantities until the addition no longer causes a precipitate. Filter off and wash the precipitate with absolute alcohol two or three times, and then dry. The result will be a white, finely divided powder, which, when thoroughly dry, is dissolved in crystallizable benzol, giving a colorless or nearly colorless solution. This solution evaporated leaves a colorless but excessively brittle layer of resin. The brittleness may be corrected by the addition of poppy oil. Thus prepared the medium is practically colorless and has a high refractive index. The residual alcoholic mixture rapidly clears itself on standing, and on evaporation leaves a tenacious but slowly drying gum that makes an excellent cement basis.—*National Druggist, December 1, 1892.*

Use of Compressed Carbonic Acid Gas for the Freezing Microtome.—A method which has been in use in the Sears Pathological Laboratory of Harvard Medical School for over two years is described by Dr. Frank B. Mallory in the *Boston Medical and Surgical Journal*. This gas, carbon dioxide, is preferable to ether or to rhigoline for freezing. The "liquid carbonate" of commerce is obtained from the American Carbonate Co., 424 E. 19th street, New York, in cylinders of 10 or of 20 pounds each, but some slight modifications are needed to adapt their cylinders

to laboratory use, and precautions have to be taken to prevent explosions. The freezing chamber of the microtome must be shallow (3-16 inch will do) so that the gas which, by its own evaporation, becomes frozen solid in it, may continue to freeze the specimen above it. The brass plate above the chamber should be thin but still strong enough to stand considerable pressure, and the floor of the chamber should be of hard rubber in order to reduce as much as practicable the loss of cold. When these difficulties have been overcome, the method combines cheapness with efficiency, and enables one with small expenditure of time to examine all the organs from an autopsy and to complete the diagnosis while the case is fresh in mind.

MICROSCOPICAL MANIPULATION.

Simple Method of Substituting Strong Alcohol for a Watery Solution in the Preparation of Specimens.—Professor W. A. Haswell, the well-known microscopist, describes in the proceedings of the Linn. Society of New South Wales, 2d series, vol. vi, the following method: “Lo Bianco has, in the last part of the ‘Mittheilungen aus der Zoologischen Station zu Neapel,’ published an account of the methods which he follows in preparing those marvellous specimens of marine invertebrates for which the station has long been famous all over the world. Many of the methods described have now been known to zoölogists for some time, *i. e.*, many of the methods of killing and fixing; it is more, perhaps, on account of the information which it gives us, as the result of a long series of trials, as to what reagents are best adapted to each special group, with the best modes of application in each case, than as giving any entirely new formulæ, that the paper is of value.

As is well known, marine animals of different groups require to be dealt with in very different ways in order that we may preserve them in anything approaching to their natural form. Some may be taken by surprise, if we may use the expression, and killed so suddenly by some powerful poison that they remain in a life-like shape. Others must be narcotized or paralyzed by some such reagents as chloroform, weak alcohol, or chloral hydrate, before the killing and fixing agent is used.

Whatever be the method of killing and fixing employed, there is in all delicate organisms a difficulty experienced in preventing shrinkage during the latter processes which the specimens have to undergo before reaching the strong alcohol stage. In the most

admirably fixed specimens shrivelling will often appear when alcohol is applied. This difficulty is partly overcome, with great pains, by using a series of alcohols of ascending degrees of strength. But the result of this mode of procedure is not by any means always satisfactory.

Dr. Cobb has described a method by which, in the case of small organisms, the shrinkage due to change from one fluid to another of different density may be reduced to a minimum. In his differentiator we have an instrument of admirable simplicity for insuring this result. But I have found that in practice the use of the differentiator involves a considerable expenditure of time. To get a specimen from distilled water to 90 per cent. solution of alcohol, for example, no fewer than eleven different mixtures of water and alcohol have to be made up and poured into the reservoir tube.

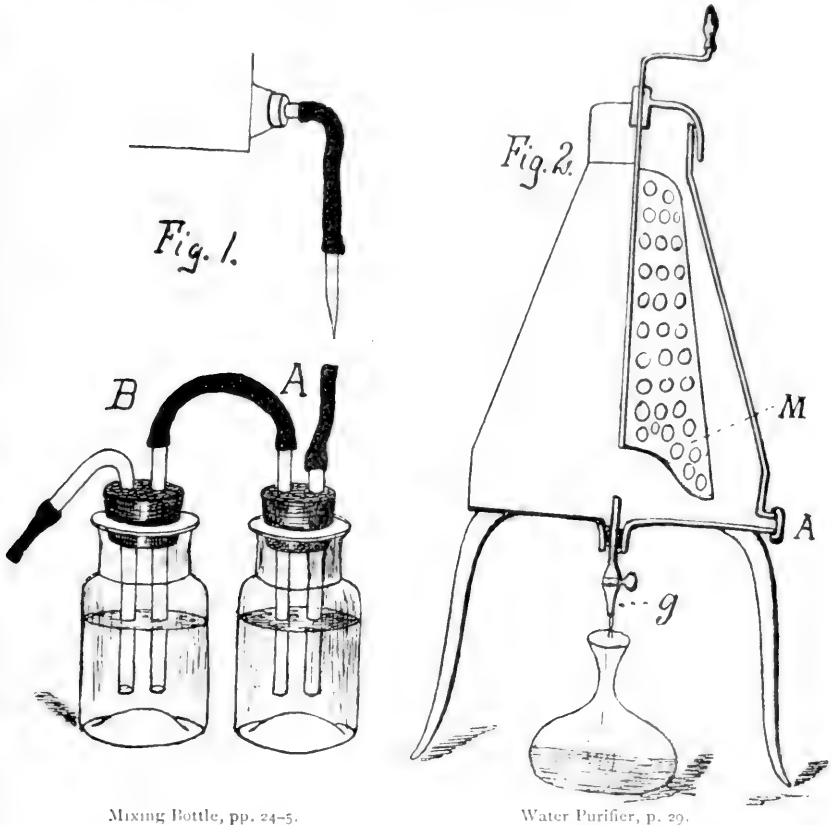
A simple piece of apparatus which I have devised does away entirely with this—the gradual substitution one for another of the two fluids of different densities being effected automatically. An obvious mode of meeting the difficulty suggests itself at once. Why not have the second fluid falling into the first drop by drop, mixing thus very gradually with it and eventually replacing it? The difficulty in the way of this is that as each drop of the much lighter liquid enters the denser, violent though circumscribed currents are produced which are damaging to the delicate organisms we are dealing with.

The requisites for the method about to be described are—several reservoirs of glass or earthenware fitted with glass taps and having each a capacity of a gallon or more, some wide-mouthed bottles of a variety of sizes, fitted with perforated india-rubber stoppers, and some lengths of glass and india-rubber tubing.

Two bottles of similar size are connected together by tubing in the way represented in the figure. One of these, A, we call the mixing bottle; the other, B, contains the objects, and must have a capacity equal to *at least* a hundred times the bulk of the latter. The objects are in fluid 1, and it is desired to substitute fluid 2. Both bottles are filled, or partially filled, according to circumstances, with fluid 1, and bottle A is connected with the reservoir of fluid 2. It is somewhat difficult by means of a tap to regulate the flow so that, let us say, one drop in five seconds will pass out of the reservoir; and it is much more convenient to effect this by intercalating in the supply pipe a section of glass tubing drawn out to the required degree of fineness (represented in the figure as disconnected from the proximal portion of the supply tube). The rate of flow through this narrow section of the tube can be further regulated by raising or lowering the reservoir or the mixing bottle, thus alternating the pressure. With bottle B is connected an overflow tube. Above the narrow section of glass tubing in the supply pipe it is well to have a piece of filter paper stretched across the mouth of the piece of

tubing in the form of a diaphragm, and held in place by the overlapping india-rubber tubing. This prevents the possibility of the narrow part of the tube being choked up by any minute particles.

Fluid 2 thus enters into the mixing bottle at an extremely slow rate of flow, and becomes completely diffused, at first in extremely minute quantity, through fluid 1. The fluid from the mixing bottle is meanwhile entering bottle B at the same ex-



Mixing Bottle, pp. 24-5.

Water Purifier, p. 29.

remely slow rate, and it is obvious that with two fluids that readily mix, fluid 1 may be made to replace fluid 2 in bottle B with the required excessive slowness and regularity.

In the case of some of the liquids used in fixing and preserving, it is not necessary to use such a precaution as this. We may substitute saturated solution of corrosive sublimate for sea-water without the least risk of damage to the most delicate structures, the specific gravity of the tube being very near the same.

Similarly distilled water may be at once substituted for osmic acid solution, or 1 per cent. chromic acid or other fluid that does not differ at all widely from water in specific gravity. But with certain fluids the gradual substitution is necessary, and it is above all necessary in replacing water on a watery solution by alcohol, and this, in the case of large specimens intended for museum purposes as well as smaller objects, can very conveniently be carried out by the simple apparatus I have described above.

Another method of effecting this substitution is the one devised by Schultze; and this seems to possess some decided advantages, at least for small objects. Schultze places the objects which he wishes to transfer from water to alcohol in a tube full of water, plugged at one end, and closed at the other by a diaphragm of chamois skin. The tube is placed in a vessel of alcohol and left there until by a process of diffusion through the diaphragm the water in the tube becomes completely replaced by alcohol, the same material being used for the diaphragm. The time which will be occupied before complete substitution takes place will vary with the capacity of the tube and the diameter of its orifice; and a series of experiments and calculations would have to be made before this method could be used with the assurance of good results. Should it be desired to have the specimens in absolute alcohol at the end of the process, some calcined sulphate of copper may be placed in the outer vessel."

BIOLOGICAL NOTES.

A Water-bug.—Our friend Zabriskie of the New York Microscopical Society found a water-bug in the waterworks of Flatbush which has been named by Bergroth of Finland *Rheumatobates rileyi*. It has also been found along the C. and O. canal above Washington. Figures and descriptions are to be found in *Insect Life* for January. This periodical can be obtained by entomologists by addressing Division of Entomology, Agricultural Department, Washington, D. C.

The insect is shy and hard to capture, which accounts for its tardy appearance in museums. It seems to prefer the vicinity of rocks and rocky beds. Specimens in various stages of development were taken in June.

Potato Scab.—Prof. H. L. Bolley announces that this disease of the potato-tuber can now be kept under entire control at very slight expense. Full details are given in a bulletin of the North Dakota experiment station. The ravages of the disease have come to be very serious, the losses averaging one-half pound per hill and often amounting to more than that figure. The disease attacks not only the tubers, but the base of the vines, resulting in

early destruction of the vines and a consequent diminution in the set of tubers. When the tubers are attacked their normal growth is checked.

The Potato Moth.—This moth (*Lita solanella*) lays its eggs on the stem of the potato, near the bottom, and at the time when the vines are nearly dead. The larvæ hatch and enter the ground, where they attack the tubers. They make burrows in the tubers, rendering them unfit for use. Even after housing the potatoes injury continues unless means of prevention are taken.

A writer in *Insect Life* advises harrowing the potato stalks up in heaps, and burning them before digging the tubers. The crop should be removed to a safe distance and covered up. The New Zealanders cover their potatoes with live shellfish, thinking that the unpleasant odor will keep away the moths.

The sparrows catch these moths in immense numbers, and have been known to practically exterminate them. This word for the sparrow, however, does not atone for his many and great sins.

House Ants of Mexico.—Edward Palmer, an entirely reliable attaché of the National Museum, writes from Tepic, Mexico, to Prof. C. V. Riley, the following strange facts:

Suddenly one afternoon these insects came into the hotel in countless numbers. They assailed the dining-room so that supper had to be taken outdoors. Next morning my room was covered with them; they swarmed over the roof, the walls, floor, and into every sheet of paper with or without botanical specimens. If I sat down to change dryers, they swarmed over me to so great an extent that I quit the room. They bit furiously. Their visit was to catch the insects that bore into the wood of the ceilings and make much devastation thereby.

Perfume of Flowers.—Ménard, by a minute microscopic study of the different parts of flowers, has discovered that the odor-producing oils are located on the inner surface of the corolla. Only a few drops of oil are usually found on the outside. The color pigments and tannin are derived from chlorophyll. The more these products are eliminated from it the stronger are the essential oils and the stronger the perfumes.

BACTERIOLOGY.

Bacillus Typhi Murium Employed for the Destruction of Mice.—Early in 1892 the field mice had so multiplied in the plains of Thessaly, near the capital town Larissa, that they had become a most terrible scourge. All means tried for combating them had failed, when the Greek government, upon the advice of Pasteur, invited Prof. Loeffler, of Greifswalde, Prussia, to experiment with this bacillus, which Loeffler had discovered and

which he had said would produce a contagious disease among the field mice as fatal as typhoid. Some cultures were prepared at the Bacteriological Institute in Athens. These were placed in water, and pieces of bread soaked therein. In order to convince the peasants that the bacilli would not harm other animals than the mice, an exhibit was made by feeding the bread to all kinds of domestic animals. Even the experimenters tasted the bread. The impregnated bread was then scattered in all directions. At the end of a month a great number of mice had succumbed. They were found in the fields with the crania open or the entrails gnawed. One of the effects of the disease is to cause the mice to come out of their holes. The well mice devoured parts of the cadavers, so that the infection once introduced propagated itself rapidly. This method of destruction has equally succeeded with house mice, although these belong, as is well known, to another species of rodents.

Whooping-Cough.—It is believed by Ritter that the bacillus *diplococcus* is the cause of this disease. He has isolated and developed the germs in agar-agar, the temperature required being about 37° F. The bacilli are very small indeed. They can be obtained from the expectorations of patients suffering from the cough.

Another Microbe.—Acosta and Grand Rossi have been studying the bank bills of Havana and the microbes deposited thereon. They found that the weight of the bills actually increased during their circulation because of the sweat, grease, and dirt deposited upon them. In these deposits thrive the microbes. In two cases the number of microbes exceeded 19,000 upon the surface observed. Among these microbes there was one bacillus which appeared special and which has been named *Bacillus billet-de-banques*. It is septic. Inoculated in rabbits and guinea-pigs, it caused them to die rapidly. There were also found the bacilli of tuberculosis, of diphtheria, and the streptococcus of erysipelas, as well as several other pathogenic forms.

MEDICAL MICROSCOPY.

Diagnosis of Tumors of the Bladder by Microscopical Examination.—Ferguson recently presented at a meeting of the New York Pathological Society a series of specimens illustrating the different varieties of tumors of the bladder, their situation and general characteristics, and dwelt particularly upon the important aid in diagnosis rendered by microscopical examinations. Exclusive of the cystoscope, he believed that the best method of making a diagnosis of tumors of the bladder was by continuous microscopical examination of the urine. This method of diagnosis is of

comparatively recent date. The method which he adopted consisted in collecting the entire quantity of urine voided during the twenty-four hours, and collecting the sediment from this by filtration through cheese-cloth. Small fragments of tissue which are found in this sediment are hardened in alcohol, imbedded in celloidin, and one or two hundred sections made and examined with a low power. If this preliminary examination reveals anything of importance, the sections are stained and examined with higher power. In some cases a sufficient number of fragments may be obtained from a small quantity of urine, and may not require to be examined for several days at a time. The present method of removing a small quantity of urine with a pipette and examining one or two slides is very unsatisfactory, but by making repeated examinations of a large number of sections of tissue much more valuable information can be obtained, and a more general adoption of this mode of examination would soon greatly enlarge our knowledge of tumors of the bladder. By this method he had made the diagnosis on several occasions, and had had the satisfaction of having its accuracy confirmed by subsequent operation.

Tumors of the bladder had, up to quite recently, been considered to be comparatively infrequent, and this was chiefly owing to the fact that at post-mortem examinations the bladder is seldom subjected to the same careful examination as are the other parts of the body.—*New York Medical Record*.

Procedure for Obtaining Germ-free Water.—Drs. V. and A. Babes describe an apparatus for obtaining germ-free water. The vessel itself is of zinc or glass, having the shape of an Erlenmeyer's flask, and capable of holding 20 to 40 litres, fig. 2, page 25. At the bottom is a pipe with stop-cock *g* for letting off the water, and at the side an aperture *A*, closed by a screw-tap, for cleaning purposes. The vessel having been filled with water, 3 to 6 grms. of powdered alum are put in, and then stirred up with a flat perforated piece of wood, or by means of a perforated mixer *M* turned by a handle. When thoroughly stirred up the mixer is removed and the vessel covered with a cap. In 18 to 20 hours the water is drawn off by the tap at the bottom. It is advisable to let the first half-litre run off. The principle on which the apparatus and procedure are founded is that of sedimentation and decantation, and though alum acts very well other substances may be used, such as sulphate of iron or chalk. A similar result was obtained by currents of air, but the details are not given. The authors think that the results of their methods are very encouraging and infinitely superior to any of the filtration methods, all of which are condemned as being worse than useless. The main objection to filters is that after having been used for a few days the filtered water contains more germs than the unfiltered. Of course all the results were tested bacteriologically.—*J. R. M. S.*, Dec. 1892, p. 886.

Insects Transmit Contagion.—Bedbugs, according to Dr. Dewèvre, may be carriers of contagion. His attention was called to this possibility by a case of tuberculosis occurring in a young man who slept in a bed formerly occupied by his brother, who had died of the disease. The room had been thoroughly disinfected, but the bedstead had escaped renovation. The Doctor observed that the young man had been bitten by the insects, and securing some of them found them full of tubercle bacilli. He put some, presumably, healthy bugs in contact with tuberculous sputum, and was able, several weeks after, to obtain from them excellent cultures of tubercle bacilli.—*Medical Record*.

Peroxide of Hydrogen.—Peroxide of hydrogen (H_2O_2) in the strong 15 volume solution is almost as harmless as water; and yet, according to the testimony of Gifford, it kills anthrax spores in a few minutes.

Dr. Paul Gibier, of New York, says:

“The destructive action of peroxide of hydrogen upon pathogenic germs, even diluted in the proportion of 3.2 per cent. solution, is almost instantaneous; after a contact of a few minutes he failed to cultivate the microbes which were submitted to the peroxide, owing to the fact that the germs had been completely destroyed.”

Many other writers have mentioned its power as a bactericide.

Cholera Bacilli are reported to live in water 1 to 6 days; in butter, 6 days; in cabbage, 3 days; on postal cards, 20 hours (dry); on silver and copper coins, $\frac{1}{2}$ hour. The authority for these statements is Prof. Uffelmann, of Berlin.

DRUG AND FOOD ADULTERATION.

Buckwheat Flour Adulteration.—Prof. L. E. Sayre, of Lawrence, Kansas, has made a report to his State Board of Agriculture on the adulteration which he has found in the market supply of buckwheat flour. A microscopic examination has shown that wheat flour and corn flour have been introduced to such an extent for the purpose of adulteration that the characteristic starch granules of buckwheat were scarcely visible in the specimens. No mineral (earthy) adulteration was found in the “buckwheat,” though the proportion of buckwheat flour was very small indeed.

Digitalis and Senna Distinguished.—Prof. Sayre writes us that these two drugs in the powdered state resemble each other so closely that their differences are unrecognizable with the unaided eye. If a sample of powdered senna is mounted and examined under a $\frac{1}{2}$ objective, numerous fragments of hairs will be found mixed up with the debris, and these are unicellular. Digitalis, on the contrary, exhibits multicellular hairs when mounted and examined in the same way. An illustration of these cells will be found in *The Microscope* for February.

MICROSCOPICAL NEWS.

Australian Fungi.—A pamphlet on this subject has just been prepared by M. C. Cooke. It is illustrated in 7 full-sized colored plates containing about 40 figures in all. There are included 38 varieties of the *Agaricus*.

Queen & Co.—The firm of James W. Queen & Co., which consisted of S. L. Fox and E. B. Fox, was dissolved on January 1, 1893. The stock, fixtures, good-will, and factories have become the property of a stock company to be known as "Queen & Co., Incorporated." The directors of the company are S. L. Fox, E. B. Fox, F. W. Stanwood, J. G. Gray, Wm. Biddle, Jr., and J. G. Biddle. The business will be continued at 1010 Chestnut st., Philadelphia.

Acknowledgment.—Mr. George Otis Mitchell, secretary of the San Francisco Microscopical Society, has sent us a nice slide of *Deutzia crenata* bleached for use with the polariscope. It looks best with no selenite, and shows white stars on a black background.

MICROSCOPICAL SOCIETIES.

Royal Microscopical Society.—The first meeting of the session of this society took place on Wednesday, October 19th, at 20 Hanover Square, W.; Mr. G. C. Karop, M. R. C. S., vice-president, in the chair.

The chairman exhibited and described Messrs. Swifts' aluminium microscope, which he believed to be the first microscope made of that metal. The chief point in the instrument was its extreme lightness, the whole thing complete, including the condenser and eyepieces, only weighing 2 lbs. 10½ oz., as against the weight (7 lbs. 13 oz.) of a precisely similar stand made, in the same way, of brass. It was perhaps not entirely correct to say that every portion was of aluminium, because there were certain mechanical difficulties met with which prevented some portions from being made of that metal; for instance, he believed it was almost impossible to cut a fine screw upon it without the thread "stripping," and it was also found extremely difficult to solder, so that all necessary screws in the instrument were made of brass; the Campbell fine adjustment was of steel, the rack-and-pinion coarse adjustment was also not made of aluminium, and the nose-piece was of German silver.

Prof. F. Jeffrey Bell read a letter received from Mr. H. G. A. Wright, of Sydney, stating that the scale of Podura in his possession was deeply notched, and that on one side of the notch an

exclamation mark had become detached and projected from the edge. Mr. Wright also sent photomicrographs in support of his statement.

The chairman said he could not be sure, from the cursory examination he had been able to make, that the exclamation mark referred to in the letter was to be seen.

Dr. C. E. Beevor read a paper "On Methods of Staining Medullated Nerve-Fibres," illustrating the subject by photomicrographs and by a number of preparations exhibited under microscopes in the room.

The chairman said they were much indebted to Dr. Beevor for his very interesting paper. It was of course a very good thing to be able to differentiate nerve-fibres in the way described, but it was a pity that they could not also so differentiate them as to show from which part of the nervous system they came. If this could be done, he need hardly say it would be of great value.

Prof. Bell read a paper by Dr. H. G. Piffard "On the use of Monochromatic Yellow Light in Photomicrography."

Mr. T. Charters-White said that he had himself tried a similar process with monochromatic light obtained by using screens and solution, but the chief difference he found was that it very much prolonged the time necessary for exposure.

Mr. T. Haughton Gill said that he had used the copper light filter for the same purpose, and had found that by its aid any good ordinary lens would give as good results as were otherwise obtained by using an expensive apochromatic, because it filtered off all the rays except those which were visually strong. He had not found in the course of his work that the use of this light prolonged the exposure; that was to say, that with a magnifying power of 300, and an exposure of ten minutes, he could, with the isochromatic plates, get a good, strong, printing image.

NEW PUBLICATIONS.

The Microscope: Its Construction and Management. By Dr. Henri Van Heurck. London, 1892.

Mr. Baxter of Sussex, England, has translated the 4th edition of Van Heurck's treatise, which, while containing elementary matter, also covers the whole field of microscopy. Abbe's theory of vision, photomicrography, and staining processes receive special attention in this edition. As to the future of microscopy, it is believed that but few further improvements will be made in the microscope. The frontispiece consists of a portrait of the famous botanical professor and director of the Antwerp Gardens.

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A Parasitic Fungus (*Heterosporium asperatum*).

By GEORGE MASSEE,

LONDON, ENGLAND,

WITH FRONTISPIECE.

Abstracted from a paper presented before the Royal Micro. Society, October 19, 1892.

This is a common and destructive parasite on the leaves of plants belonging to the order Liliaceæ, and has been observed on plants belonging to the following genera: *Convallaria*, *Smilacina*, *Smilax*, *Polygonatum*, and *Maianthemum*.

In common with many parasites, the fungus does not appear on the surface until the leaf becomes more or less dry and discolored, and on this account its presence has been considered by some as the result rather than the cause of the disease; but in reality the vegetative mycelium is present in the tissues of the leaf for some time before there are any external signs of its presence.

In *Smilacina stellata*, as in the other host-plants of the fungus, the tip of the leaf has a slight oblique twist that retains

EXPLANATION OF PLATE.

Fig. 1. *Heterosporium asperatum* on portion of a leaf of *Smilacina stellata* Desf., nat. size.

" 1a and 2. Spores germinating in a sterilized solution of the host-plant (20 hours). x 500.

" 3. Spores germinating in a solution of the host-plant (48 hours); a, secondary spores; bb, anastomosing hyphæ. x 500.

" 4, 5. Spores germinating in water (80 hours); a, secondary spores; b, anastomosing hyphæ; c, a hyphal branch that has formed a loop by curving and anastomosing with the parent hypha. x 500.

" 6. Old sporophores that have produced secondary spores after remaining in water for four days; a, secondary spores; b, sporophores. x 500.

" 7. Spores germinating in a solution of leaf of sunflower; a, sessile whorls of secondary spores. x 500.

" 8. Spores germinating in water containing a trace of glycerin. x 500.

Fig. 9. A fascicle of sporophores bearing spores; a, the sclerotoid base from which the sporophores spring; b, a portion of the hyphæ that produce the sclerotoid base. x 500.

" 10. A stout hyphal branch running between the cells of the host-plant and giving off slender branches that penetrate into the cells of the host. x 500.

" 11. A stout, dark-colored portion of mycelium growing in a dead leaf, and bearing two sclerotia. x 500.

" 12. A sclerotium producing secondary spores in a solution of the dead leaves of the host-plant (80 hours). x 500.

" 13. A pycnidium produced by stout, dark-colored hyphæ in a dead leaf of the host-plant. x 500.

" 14. Section of a portion of the wall of a pycnidium, showing the origin of the pycnospores. x 500.

a small quantity of moisture, and it is at this point that the parasite very frequently first shows itself; the secondary spores being caught, and their germination favored, by the film of water present; nevertheless, it may be stated that a yellow patch is often present at the point indicated, in which no trace of mycelium can be detected, and which appears to be entirely due to the action of water.

The disease is frequently produced by direct application of the secondary spores to damp portions of the surface of the leaves, and although morphologically there appears to be but one species of the fungus under consideration, yet there are what may be termed distinct biological forms of this species; the secondary spores produced by the fungus developed on one species of host-plant rarely cause the disease when sown on the leaves of a host belonging to a different genus, although both species of hosts have their own form of the fungus.

The secondary spores usually germinate within twelve hours of being placed in water, and emit from one end a single, unbranched, very sparsely septate tube about 1.5-2 μ in diameter; this mycelium, when produced on the surface of a suitable leaf, soon enters by way of a stoma into the interior. When once within the leaf, the mycelium at first forces its way between the cells of the host, the main branches soon acquiring a thickness of 8-10 μ , and becoming transversely septate, the cells averaging 2-3 times as long as broad (Fig. 9); by degrees the walls of the hyphæ become tinged brown, and with age are dark brown and nearly opaque. Thinner lateral branches are given off at intervals by the hyphæ described above; these at once pierce the wall of an adjacent cell, pass into the interior, and form a complicated coil (Fig. 10), their function being that of assimilating food at the expense of the contents of the cell.

Within a fortnight after first entering the leaf, the mycelium has usually radiated from the point of injection and formed a more or less circular patch about 1 cm. in diameter, and of a pale yellow color; this patch has now sunk below the ordinary surface-level of the leaf, owing to the collapse of the epidermal cells. In the meantime numerous short, lateral branches of the primary hyphæ have developed a pseudoparenchymatous mass of tissue at the apex, the superficial cells of which give origin to the sporophores (Fig. 9). The sporophores, when fully developed, measure 120-150 μ in length by 8-10 μ in diameter, and are divided into 6-9 cells by transverse septa. The walls when matured are brown, becoming paler upwards. The basal cell resting on the sclerotoid base is inflated. During the growth of the sporophores, the basal cells of the sclerotoid base send out colorless hyphæ; these penetrate the cells of the host for the purpose of obtaining food (Fig. 9).

At the moment of maturity, the spores germinate within twelve hours when placed in a suitable medium. When germi-

nation takes place in water, whether in artificial culture or in a drop of water on the surface of a leaf of the host-plant, the germ-tubes are very slender, equal, simple, or sparingly branched, spirally curved, transverse septa very rare, and the fusion between originally distinct tubes or branches very rare, or in most cases entirely absent (Figs. 4 and 5). About two days after germination has commenced, one or more short lateral branches spring at right angles from the germ-tubes; these may be considered as specialized sporophores. The apex of each sporophore becomes slightly incrassated, and within a day produces several simple or branched concatenate chains of elliptical, pale olive, smooth secondary spores. These secondary spores are developed in acropetal order (Fig. 4a).

When the spores germinate in a sterilized solution of the host-plant (*Smilacina stellata*), the germ-tubes measure 5-6 μ in diameter at the point of origin from the spore, become elongate, never spirally twisted, and gradually taper to the apex; transverse septa are abundant; the clusters of secondary spores are about equal in number, and the secondary spores of the same size as those produced on the very slender germ-tubes formed by spores germinating in pure water (Fig. 3). In both instances sporophores bearing clusters of secondary spores are not unfrequently produced directly by interstitial cells of the spore without the intervention of a germ-tube (Fig. 3a - and Fig. 5a+).

Throughout the summer months the spores germinate as soon as mature, at the ordinary temperature of the air; but the later batches of spores produced in September and October will not germinate, or very feebly, at the temperature of the air; such spores remain passive during the winter, and germinate the following spring. Nevertheless, these are not resting spores—in the ordinary sense of the term—but will germinate at any period throughout the winter, provided the temperature is sufficiently high.

During the summer the isolated patches of disease that correspond to independent centres of infection increase in size and run into each other, the whole leaf not unfrequently presenting a blackened appearance, caused by the dark-colored hyphæ.

During the autumn the stronger branches of the vegetative hyphæ increase considerably in thickness, many of the cells becoming very much inflated and spherical and separated by deep constrictions, due to the transverse septa not increasing in diameter. Many of these stout hyphæ become more or less irregularly branched and contorted at the tip, the convolutions approach each other, and by repeated cell-formation produce a more or less globose sclerotium-like body, almost black externally, somewhat paler inside (Fig. 11). These sclerotia remain passive during the winter. In the following spring certain of the external cells of the sclerotia become more prominent than the rest, and

eventually grow out in a radiate manner from the sclerotium as slender, colorless, septate hyphae or sporophores, each producing at its apex a whorl of simple or branched concatenate chains of small, elliptical, olive spores that agree in every particular with the secondary spores borne on the mycelium of the germinating spores (Fig. 12). The spores produced by the sclerotia, when placed on the leaves of the host-plant, produce the *Heterosporium*.

Fig. 6 represents two sporophores of the *Heterosporium* after remaining in water on a slide for four days; it will be observed that two slender filaments have developed, each bearing a fascicle of change of spores similar to the secondary spores borne on the filament of germinating spores.

Finally, if leaves infested with the *Heterosporium* are examined in the autumn, blackish perithecia will in many instances be found: these bodies are subglobose, slightly attenuated upwards, furnished at the apex with a minute aperture, and when mature have the inner surface covered with very short sporophores, each bearing at its apex a minute body, resembling in every respect the secondary spores of *Heterosporium* spores. These minute perithecia originate from mycelium closely resembling that of *Heterosporium*, but I have not seen any suggestion of a resemblance to these bodies in any of my cultures, neither have I succeeded in causing the spores of these structures to germinate: consequently their relationship or otherwise with *Heterosporium* is at present unknown; it is certain, however, that these bodies have no necessary control over the continued development of the *Heterosporium*.—J. R. M. S.

Microscopical Technique Applied to Histology.—I.

(From the French of M. René Boneval.)

[The following chapters are abstracts of M. René Boneval's admirable "*Nouveau Guide Pratique de Technique Microscopique appliquée à l'Histologie et à l'Embryogenie*," a work of such excellence and one so well adapted to its purpose (that of instructing the beginner in the preparation of histological material), that the translation is offered to our readers in the hope that at least some will be thereby induced to study the structure of animal tissues, and that those engaged in teaching the novices in histology will find its elementary methods helpful. The formulae and methods given by M. Boneval are those which he has proved to be trustworthy, and those which any intelligent beginner may prepare and use without further aid. The chemicals needed are usually only such as any good drug-store can supply or any dealer in microscopical materials furnish at small cost. It is assumed that the reader is familiar with the use of the

microscope, and with the elements of microscopical mounting.
—THE TRANSLATOR.]

PART I.—GENERAL METHODS.

The tissues and organs whose structure and texture—that is, the nature and the arrangement of whose constituent anatomical elements are to be determined, should be subjected to a series of anatomical methods which we shall describe by showing how to make and to use the reagents.

1.—A first method allows of the separating of the organs into thin slices to be examined by transmitted light; this is *section cutting*, which we place at the head of general methods, since its discussion permits nearly all the reagents to be passed in review.

2.—When organs are membranous they can be examined flat on the object-carrier, without the use of the preceding method; this is the method of *extension of membranes*, which, as we shall see, is of great importance.

3.—Having learned the arrangement of cells, it is necessary to study their form and structure by dissociation, which allows the anatomical elements to be separated from one another.

4.—We place last the *examination of living objects*, because this is delicate work, productive of many errors, and to be employed only after one has become familiarized with microscopical observation.

METHOD BY SECTION CUTTING.

This comprises a number of manipulations. The object is to be fixed and hardened before being cut; the sections are then stained and mounted in the proper preservative.

FIXATION OF TISSUES.

The purpose of this is to kill the anatomical elements, and to coagulate the living material so that, fixed in its natural form, it can without change be subjected to the action of reagents. Fixing should be done with great care. . . .

1. Use material perfectly fresh, alive if possible, under penalty of fixing cadaveric changes which might be mistaken for normal structure. This rule should be strictly observed in pathological observations, which in general should not be made more than twenty-four hours after death.

2. Place only small fragments in the fixing liquids. . . . If a good fixation is desired the size should not exceed a square centimetre with alcohol, and a millimetre with osmic acid.

3. Make a judicious choice of the fixative, and use it in *very large quantity*. A fixative that will act well on one organ may act badly on another. If without previous experience, one should place portions of an organ in several fixatives, selecting preferably alcohol, bichromate of ammonia, osmic acid. We cannot too often repeat that an amount of the fixative should be used equal

to forty or fifty times the volume of the specimen. There is only one exception—when the fixatives are powerful and expensive (osmic acid).

Alcohol.—Three concentrations are used: Ranvier's $\frac{1}{3}$ alcohol, equally excellent for dissociating and for fixing. It is made of alcohol, 30° C., one volume, with two volumes of water. Alcohol of 90° is used daily in pathological anatomy. Portions of tissue not exceeding a square centimetre are suspended in it by a thread. A tissue capable of contracting—a bit of skin, for instance—is spread on the bottom of a dry saucer, and while it is held with two needles 90° alcohol is poured over it; in a few moments the needles are removed, for then the skin will not contract. This rule should be observed, otherwise we are apt to have deformed specimens or those which cannot be cut in any selected direction. Although good preparations may be made of specimens that have been long in alcohol, it is better to take them out in from 24 to 48 hours. Absolute alcohol is rarely used as a fixing reagent. Specimens should not be left in it for more than a day or they will not stain well. The beginner should procure the one-third, the 90°, and the absolute alcohol. The last is exceedingly useful for many purposes. . . .

Osmic Acid.—This is the fixative *par excellence*. . . . As the cost is great and since the solution is unstable, the latter should be made with certain precautions. A white or yellow glass bottle is washed with sulphuric acid. (It is not the light but organic matter that reduces the solution. The bottle should have a glass stopper.) Rinse with distilled water to remove every trace of acid. The little tube containing the osmic acid is well washed in alcohol, nicked with a file, and glass and acid are put into the bottle. Add 50 c. c. of distilled water. A 1 per cent. solution is generally used. If the cleansing has been perfect the solution will remain clear. It is used as a vapor or in solution.

Fixation by the vapor is easiest and most efficacious for small objects. With free elements—blood, for instance—invert the slide over a wide-mouthed bottle in which is a little osmic acid. In a few minutes the fixation is perfect, and the preparation can be stained and mounted. Larger objects (not exceeding 1 mm. square) and membranes are fastened by pins to a cork which then stops a wide-mouthed bottle containing 1 c. c. of osmic acid. Fixation is here slower. The acid should be allowed to act for from 10 to 15 minutes or even longer. Wash rapidly in distilled water, stain or keep in alcohol for sectioning. When a tissue is placed directly in the 1 per cent. solution, the specimen, we repeat, should be as small as possible (1 mm.). In a bottle with ground-glass stopper place 2 c. c. of the solution. The tissues remain there for a variable time; 6 hours are usually sufficient. The specimen should be carefully washed in many waters till all odor has been removed (10 to 12 hours); preserve in 70° alcohol.

If the washing is not carefully done the specimen will continue to blacken in the alcohol. This should be avoided.

Bichromates.—The bichromates of potassium and of ammonia are advantageously used, instead of chromic acid; sometimes with it. A solution of pure bichromate of ammonia in water (2 per cent.) is made, or the mixtures called Müller's or Erlicki's fluids are used.

Müller's fluid does not differ in its properties from the pure bichromate. Its formula is: Water, 100; bichromate of potassium, 2; sulphate of soda, 1.

Erlicki's fluid fixes better and hardens quicker than the pure bichromates, especially if it is placed in a stove heated to about 37° C. It is useful for the central nervous system; in 8 days a remarkable consistency is obtained. The formula is: Bichromate of potassium, 2 grms.; sulphate of copper, $\frac{1}{2}$ gm.; water, 100.

In a general way bichromate solutions should be used to fix vascular specimens when the blood-corpuscles are to be preserved; also for injections with Prussian blue, and whenever the nucleus is to be stained with hæmatoxylin. Tissues should remain in the chromic salt for at least 10 days (a longer time will do no harm), and carefully washed in many changes of water for 24 hours. They are then ready to be imbedded for sectioning.

Picric Acid.—This is used in a saturated aqueous solution. Picric acid is a fixative of the first order; it is advantageously used, instead of the bichromates, for the study of blood-vessels. Small pieces (few mm.) should be left in the solution for not longer than 24 hours. Transfer to strong alcohol.

Bichloride of Mercury.— To prepare the solution, dissolve an excess of the bichloride in distilled water. To fix the tissues of vertebrates, use it cold. Very small pieces should remain in it only till fixation is complete. When entirely whitened (in from 5 to 6 hours), transfer to strong alcohol and renew it many times. Do not use metallic instruments in the manipulation of the specimens.

HARDENING.

The foregoing fixing agents often harden the tissues sufficiently to allow of sectioning. It is possible to make sections free hand after the action of alcohol, of osmic acid, of picric acid, or of the bichromates, yet it is necessary, especially with the last mentioned, that the action be prolonged for several months. But great experience is here needed, and it is better to complete the hardening, as may be done by placing the fixed tissues in strong alcohol, but as the beginner will often find the piece not hard enough to section in this way he should have recourse to methods of imbedding.

The imbedding or the imbibition by the organs of the proper substance is intended to increase the consistency of the tissues and to prevent the disarrangement of the elements or of the parts of small specimens (embryos, for example). There are many

imbedding methods. The following are practically useful: imbedding in gum, in celloidin, and in paraffin.

Imbedding in Gum.—This is simple and should be used for ordinary, every-day work. The imbedding substance is a solution of gum arabic. Make a thick mucilage with water and add a crystal of carbolic acid to preserve it. For imbedding the thick solution is thinned by water until entirely clear.

Tissues fixed by the foregoing reagents are to be thus prepared for imbedding: The pieces taken from alcohol are placed in a large vessel of water to remain till they sink to the bottom, where they should lie for about 30 minutes. This procedure expels the alcohol, which would prevent the entrance of the gum. Pieces from osmic and picric acids and the bichromates should also be washed in this way. . . . The specimen is placed in a wide-mouthed vessel (a saucer is admirable for this), into which the mucilage is poured till the object is entirely covered. In from 24 to 48 hours the tissue will be saturated. A very thin solution of gum should be used, as it penetrates the tissues better, and will thicken as the water evaporates. With bibulous paper remove the layer of gum from the surface, and place the specimen in a large quantity of strong alcohol for from 24 to 48 hours. It may be suspended by a thread, but this is unnecessary if the amount of alcohol is sufficient.

Imbedding in Celloidin.—Collodion may be used, but celloidin is preferable, and may be procured in tablets of from 40–50 grms. Cut into small pieces and place them in a mixture of equal parts of absolute alcohol and of ether. Make two solutions—one very thin, the other syrupy.

The specimen, removed from 90° alcohol, is placed for 24 hours in absolute alcohol. . . . Transfer to absolute alcohol with an equal volume of ether. In a few hours, one day if the piece be large, it is placed in the thin celloidin for 24 hours, then into the celloidin syrup. It is difficult to indicate the hours needed for the penetration of the syrup, as it varies with the nature of the tissue. Two or three days are a medium time, but it is better to be too long than not long enough.

The saturated piece is placed in a little paper box filled with the syrup, and the ether evaporated till a pellicle forms on the surface. The evaporation should be slow; therefore cover the box with a bell-glass. The hardening is finished by plunging the box into 82° alcohol. For small objects chloroform may replace the alcohol. With it a consistent substance may be obtained more quickly than with alcohol. We thus obtain a transparent mass from which we carve a block containing the object, and preserve it in 82° alcohol or in chloroform till ready for sectioning.

[To be continued.]

Influence of the Study of Bacteriology in the Development of Aseptic Surgery in the Hospitals of Paris in 1892.

By ROBERT REYBURN, A. M., M. D.,

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WASHINGTON, D. C.

Having during the past six years made three visits to Great Britain and the continent of Europe—viz., in 1886, 1890 and 1892—I have studied with much care and interest the progress and development of aseptic surgery in these countries. During the summer of 1892 I paid special attention to what I saw of the surgery of London, Berlin, and Paris. The present paper will treat only of aseptic surgery as I saw it in the hospitals of Paris in 1892. The history of the influence of bacteriological studies in the development of aseptic surgery is one of the most interesting and important of the modern discoveries in the science of medicine. The wildest dreams of our imagination could never have foretold the momentous consequences that would result from the discovery and investigations of the Bacteria and other minute micro-organisms. It is a striking illustration of the fact that we often do not, and cannot, appreciate how far-reaching and important a scientific discovery may be, even when it seems to have no practical use or benefit at the time. To the great Professor Pasteur's labors, chiefly, we owe the foundation upon which antiseptic and aseptic surgery have been built. He demonstrated that the processes of fermentation and putrefaction are entirely due to the presence and action of these microscopical germs, and if they are absent these changes will never take place. This was followed by the labors of Prof. Tyndall, of England, who proved conclusively that if we would completely exclude the living germs or bacteria of the air from infusions of animal or vegetable matter they could be kept indefinitely.

Infusions such as beef tea, mutton or chicken broth, and infusions of hay and other vegetable structures may be kept for years if, after boiling to sterilize or kill the living germs contained in them, they were hermetically sealed to exclude the air which contains the germs. He found also if the mouths of the vessels containing these infusions were plugged up with aseptic cotton, to filter out the germs as the air passed in and out, that these infusions could be preserved indefinitely.

To Prof. Lister we owe the grand idea of excluding the bacteria and other germs from wounds, and thus creating the then new science of antiseptic surgery. It is perfectly true that aseptic surgery as now practised in this country and in Europe is very different, and far superior in efficacy and simplicity, from the cumbrous procedures and dressings devised and practised by the father of antiseptic surgery; nevertheless we must never

forget that to Prof. Lister we owe the practical development of the principles underlying what we know to be the true science of aseptic surgery.

The carbolic spray once universally applied has been almost entirely abandoned, and during my recent visit to Europe I never saw it once used. The many layers of protective gauze, mackintosh, etc., are now replaced by a simple layer of iodoform gauze, with an abundant layer of pure aseptic cotton firmly retained by bandages.

Another remarkable change is in the growing disbelief in the efficacy of the ordinary antiseptic solutions when used as germicides. Solution of carbolic acid has been shown to be a very weak germicide, and the same may be said of solution of boric acid and of the other solutions commonly used for this purpose. Bichloride of mercury has been our sheet-anchor as a germicide until the present time. As we lost our faith in one germicide after another, we thought we could rely on that. Yet the iconoclasts are busy in their work of tearing down all idols in medicine, and now they have not left us that one. Recent investigations carried on at Johns Hopkins University and published in the Johns Hopkins Hospital Bulletin of April, 1891, p. 59, have shown that solution of bichloride of mercury when used as a germicide is often inert and still oftener actually injurious to the tissues when applied during surgical operations.

The great surgeon Lawson Tait believes in no germicide except recently boiled water, and observation teaches me that the consensus of opinion of the great masters of surgery is fast settling upon the conviction that there are practically only two methods of keeping wounds aseptic. One is to keep wounds made during surgical operations as dry as possible, and the other is to use only recently boiled water in contact with them. Every instrument and surgical appliance must be sterilized, either by boiling in water containing soda, or by being exposed to dry heat above the temperature of boiling water for at least one-half hour.

To this, of course, must be added microscopic cleanliness of the operator, assistants, nurses, and all the appliances used in surgical operations, and, of course, including the operating-room and all the surroundings. The present paper will, however, be confined to aseptic surgery as I saw it in three of the Paris hospitals, namely, Hotel Dieu, Hospital Tenon, and the Hospital Bichat. Hotel Dieu, the oldest hospital of Paris, was originally situated on the south bank of the Seine, and the old building is said to have been founded by Clovis II. in the year 660. The present building is located on the north side of the Place Notre Dame, and was rebuilt in the years 1868-1878.

It is like many of the European hospitals, quadrangular in shape, with a courtyard in the centre, and accommodates about eight hundred and fifty patients.

The hospital is clean and well ventilated. Contagious diseases

are not usually admitted to this hospital, but are sent to special hospitals. Some cases of cholérine (so called) were in the hospital, and I saw in an English paper a statement that one hundred cases of cholérine (or cholera) had been admitted to Hotel Dieu the day we left Paris. I am unable to state of my own knowledge whether any of the cases of cholérine were really Asiatic cholera or not, but I saw in the morgue of the Hotel Dieu several bodies of patients who had died from this disease.

Hotel Dieu has a very large number of patients attending daily for the purpose of being operated upon and prescribed for, and these clinics are truly immense. The most famous surgeons of Paris are numbered among the hospital staff. Those on service at the present time are Lancerreux, Tillant, Verneil, Panas, Proust, Corneil, Brequoy, Labbe. Dr. Henri Hartman, whom I met for the first time on August 25, 1892, is also one of the surgeons of the hospital of Hotel Dieu, and to him I am indebted for many courtesies during my stay in Paris.

He invited me to meet him at the Hospital Tenon on the following day, August 26, 1892. Hospital Tenon is a new hospital, containing about one thousand beds, and in point of cleanliness and ventilation was in an admirable condition. I examined with great interest the lying-in wards, and found the most perfect arrangements for antiseptics in them. From 60 to 80 confinements take place there per month, and since the introduction of strict asepsis the mortality from childbirth has been so greatly reduced as to be almost nominal.

The management of all the Paris hospitals is entirely vested in a Council of Administration, who make the appointments of surgeons and directors of the hospitals. All the subordinate positions, such as internes (or what we call resident physicians or students), are filled by concours, or competitive examinations. This same system is applied to the promotion of nurses and other employees of the hospital. At the last concours, out of 627 candidates for the position of interne, only 56 appointments were made.

The course of study for a student of medicine in Paris extends over a period of five years, and the college fees amount to almost eight hundred dollars per year.

Bacteriological laboratories are found in nearly all the Paris hospitals, and the internes or resident students are evidently familiar with their use, and are in every respect a high class of men. They are thoroughly competent in the performance of their duties, and in the absence of the senior surgeons are almost daily called upon to perform many of the gravest operations of surgery.

August 26 and 27, 1892, I visited, with Dr. Henri Hartman, the Hospital Bichat, and there found what I considered to be an ideal hospital. Hospital Bichat is small, consisting of only two wards, one for males and the other for females, and each

consisting of about sixty beds. These two wards are connected by an operating ward, containing ten or twelve beds. There are also the necessary administration buildings.

This hospital is used only for operations, and patients who are waiting their turn to be operated upon. I saw there aseptic surgery carried out with a perfection of detail, and with such successful results, that I certainly have never seen equalled elsewhere. I saw there six cases of laparotomies in various stages of recovery after being operated upon—cases of cholecystectomy, nephrectomy, vaginal hysterectomy, amputations, and indeed all the graver operations of surgery, almost all, as the histories of the cases show, recovering without rise of temperature or suppuration. They start out in the Hospital Bichat with the assumption that if an operation is aseptically performed by an aseptic operator on an aseptic patient, that there ought to be neither fever nor suppuration following a surgical operation. If rise of temperature takes place the operator is at once attacked and blamed for imperfect surgery. If an operator has three or four such cases in succession, they have a nickname for him; he is called *cochon sale* (in English, a dirty hog).

Time will not permit me to describe all the interesting surgical cases I saw. Among them was a case of ligation of femoral artery on account of a traumatic aneurism, caused by erosion and penetration of the artery, by a sharp exostis on the femur. The artery was cut down upon and ligated above and below the injured portion, with a successful result.

Another case was one of necrosis, involving nearly all of the shaft of the femur. After the removal of an immense sequestrum, the cavity was filled up by the fresh and aseptic bone from a calf. This was broken up about as large as coarsely ground coffee, and then the cavity was filled up with it, with the result of the formation of a firm and solid thigh bone. This case was operated upon about six weeks before I saw it, and was about to be discharged cured. Another case of a similar kind was awaiting operation. Dr. Hartman acknowledged that he had received the idea of doing this from an American surgeon, Dr. Senn.

On Saturday, August 27, a woman was brought into the Hospital Bichat apparently dying, temperature 107.8, pulse scarcely perceptible, and partly delirious. The case was one of suppurating ovarian cyst, which had burst into the cavity of the peritoneum. After wrapping her in hot blankets and administration of stimulants, a slight reaction set in and laparotomy was immediately performed. The next morning, at 9 A. M., I saw her and she was rational, pulse nearly normal, and scarcely any fever. It seemed almost like seeing a woman raised from the dead.

The methods of operating are of the simplest character. The arms and hands of the operator and his assistants are of course thoroughly cleansed with soap and solution of corrosive sublimate 1-2000, as well as the part of the patient's body where the opera-

tion is to be performed. As few instruments as possible are used and these having recently been sterilized by boiling water or dry heat at the temperature of 220 Fahr. No sponges are used, their places being supplied by the use of balls of aseptic cotton. In the case of an amputation no ligatures are used for the vessels except such as silk-worm, gut or catgut, and these are cut short. No drainage tubes are used, or in fact anything that will prevent union by first intention. No plasters are used on the stump for fear of infecting the wound, as it is impossible to sterilize the usual adhesive plasters often used to keep the flaps of the stumps in close apposition. The stump is dusted with iodoform, and iodoform gauze applied; then a very liberal supply of layers of aseptic cotton wool, firmly retained by properly applied bandages.

The operator must not, of course, touch anything from which infection might be conveyed to the wound. He is not allowed even to pass his hands over his own face or to touch any part of his body with his hands during an operation.

Such minute precautions as these may seem to some needless, but such is not the case, for, as has been well said, "perfection is made up of trifles, but perfection is no trifle." After a somewhat long and varied experience in surgery, I must say that I have never seen such fineness of technique and such magnificent results of surgery as I beheld in the Paris hospital. To Dr. Hartman, as well as to his assistant, Mr. Wm. S. Magill (hospital interne), I am greatly indebted for so freely showing me the cases in the hospital.

It is rare to find a surgeon in Paris to have attained any eminence before the age of 50 years. Dr. Hartman, I am informed, is only 32 years old, and is now acting as surgeon in three of the Paris hospitals. With hearty good wishes, I venture to predict for him a brilliant and useful career.

Diatoms of the Connecticut Shore.—IV.

By WM. A. TERRY.

BRISTOL, CONN.

The clayey earth forming the diatomaceous deposits at Morris creek, Branford river, Stony creek, and Leete's island is of a bluish color, and dries a light gray. The clay when purified from the fine sand and organic matter is purely white. The Leete's island deposit has several strata containing decayed shells. At a point about one mile distant from the open water, at the mouth of the creek, and from five to ten feet below the surface of the deposit, occur strata showing abundance of fragments of shells of the oyster, clam, mussel, water snail, periwinkle, conch, etc.; proving a considerable depth of salt water here at the time this part of the deposit was laid down, and this is some

twenty feet above the bottom of the deposit. What the strata below this contains I have not yet found out, but hope to do so hereafter.

On the north side of the island the marsh widens out into what was once a broad bay, and extends northward for some miles; under all this marsh lies the diatomaceous clay. Much of this clay is by no means rich, but all contains some diatoms, not a single ounce that I have examined but what would yield diatoms enough for many dozen of slides. Since my previous article was written I have partially explored Leete's Island creek. I find it, like Morris and Stony creeks, rich in *P. americanum*. In a ditch flowing into this creek I find *Pleurosigma terryanum* with *Navicula maculata*, both in such abundance that they may be easily separated from other forms, and form by themselves a nearly pure gathering; with them appear also in abundance of *Navicula permagna* of a peculiar type, and large specimens of *Nitzschia scalaris*.

This I consider a choice find. I have never heard of anything like it elsewhere, and I think all the Leete's island slides specially interesting. I have lately examined the upper stratum from different points, and find it extraordinarily rich in *Navicula didymus* and other types of *N. constricta*, and also the different types of *N. elliptica*.

West of the depot a new track has been laid through the marsh, and in building bridges and culverts a considerable amount of the deposit has been thrown up; this contains the same *Coscinodiscus*, *Actinopterychus*, *Amphora*, *Rhabdonema*, *Navicula*, *Scolio-pleura*, *Orthosira*, *Surirella febegeerii*, with a larger amount of *Actinocyclus crassus*, *Auliscus sculptus*, *Campylodiscus echeneis*, etc. Of recent material I found, in one gathering from a ditch near the culvert, *Pleurosigma balticum*, *P. terryanum*, *P. ostrigilis*, *P. americanum*, *P. decorum*, *P. elongatum*, *P. (Colletonema) eximium*, *P. brebissonii*, *P. fasciola*, *P. paradoxum*, *P. angulatum*, *P. affine*, and many others, with sigmoid *Nitzschia*, large and small, in such annoying abundance that it was impossible to separate the *Pleurosigma* so as to make a satisfactory slide.

In my description of the diatoms of New Haven harbor and neighboring waters, published some years ago in this JOURNAL, I mentioned that *Pleurosigma angulatum* was universally distributed in these waters. In this statement I was misled by various experts to whom the slides were sent for determination; I now find that the species they called *angulatum* was *P. affine*, which is found nearly everywhere on the Connecticut shore, *P. angulatum* being comparatively rare in deeper waters, and appearing only occasionally in the shallow water of ditches and tide-pools. The large *P. balticum* var. *maxime* is found in nearly all the shallow tide-pools near the open salt water; with it frequently appears *P. elongatum*, and sometimes *P. angulatum*; the tide-

pool and ditches farther from salt water and more nearly fresh occasionally contain *P. terryanum*, sometimes mixed with *P. balticum*, but frequently entirely pure. *P. americanum* is found chiefly in the waters of tidal creeks, and *P. decorum* and the smaller form of *P. balticum* in the more saline and deeper waters of coves and bays. The native habitat of *Actinocyclus barkleyi* is on the bottom of the larger tidal creeks, or in ditches and marshes of an estuary of a fresh-water river.

The tide-pools in the marshes on the banks of Branford river are very rich in *P. balticum*, and some of them contain *P. angulatum*. *Surirella striatula* and the larger sigmoid *Nitzschia* are also abundant. The fossil deposit of diatomaceous clay underlying these marshes I have had but little opportunity to examine, as no excavations have been made. It differs from the others described, in that the upper layer just below the peat contains abundance of *Campylodiscus echeneis*, so that slides can be made from it in which the *Campylodiscus* is entirely pure. The stratum just below this is very rich in species, somewhat resembling the Leete's island deposit. Dr. D. B. Ward sends me the following determination of the forms in a single slide from this stratum of the deposit which I sent him, marked No. 1, B:

<i>Coscinodiscus excentricus</i>.	| <i>Pleurosigma balticum</i> .
“ <i>oculus iridis</i> .	“ <i>affine</i> .
“ <i>subtilis</i> .	“ <i>formosum</i> .
“ <i>radiatus</i> .	<i>Navicula formosa</i> .
<i>Scoliopleura tumida</i> (abundant).	“ <i>marina</i> .
<i>Nitzschia acuminata</i> .	“ <i>formosa</i> var. <i>hiburnica</i> .
“ <i>sigma</i> .	“ <i>erucicula</i> .
“ <i>elongata</i> .	“ <i>elliptica</i> .
“ <i>plana</i> (and several others).	“ <i>peregrina</i> .
<i>Actinoptychus undulata</i> .	“ <i>oblonga</i> .
<i>Tryblionella hantschiana</i> .	“ <i>lyra</i> .
“ <i>punctata</i> .	“ <i>interrupta</i> .
<i>Cyclotella striata</i> .	“ <i>digita radiata</i> .
<i>Rhabdonema adriaticum</i>.	| <i>Campylodiscus echeneis</i> .
<i>Surirella febegeerii</i>.	| <i>Pyxilla baltica</i> .
“ <i>striatula</i>.	| <i>Tropidoneis seriata</i> .
“ <i>fastuosa</i> var.	| <i>Raphoneis amphicerus</i> .
<i>Cocconeis scutellum</i>.	| <i>Plagiogramma gregorii</i> .
<i>Melosira sulcatum</i>.	| <i>Amphiprora conspicua</i> .
<i>Stauroneis gregorii</i> .	

He adds: “There are several *Nitzschias* and *Amphoras* which I did not look up.”

The stratum next below this is of finer clay, containing mostly lighter varieties, with many species of *Pleurosigma*.

Dr. Ward determines two of the forms to which I called his attention as: “*Triceratium (ditylium) brightwellii* var. *inaequalis* Grun. = *Ditylium inaequale* Bail.

“*Navicula (Van Heurckia) rhomboides* var. *amphipleuroides* Grun. Cleve & Grunow, Arctic Diatoms, Pl. iii, f. 59.”

I have so far examined only the three uppermost layers of the

Branford deposit, all from one place. I have reason to believe this deposit quite extensive, as Branford river is an inlet of considerable extent. The Stony creek deposit has also been only slightly examined, for the same reason.

The home-made boring apparatus I use in searching for fresh-water fossil deposits around home is too unwieldy to carry on expeditions of from thirty to fifty miles, and is, besides, incapable of reaching the required depth. Digging in these marshes is difficult under ordinary circumstances, as the investigator is driven off every few hours by the advancing tide.

Only a portion of the species found in my explorations have been mentioned in these articles. I wait for the publication of special monographs by recognized authorities, and also the result of future investigation.

Has the Fresh-Water Sponge a Nervous System?

By J. M. STEDMAN.

TRINITY UNIVERSITY, DURHAM, N. C.

Recently I collected a few branches of *Spongilla lacustris* and placed them in alcohol. Later, I sectioned portions of a branch for histological study, and to my surprise discovered what I take to be a nervous system. It consists of cells which have a more or less thick spindle or star-shape, terminating in one or more—rarely four—long thread-like processes, usually at each end, which unite with the other cells directly or extend for a considerable distance before so doing. The protoplasm is granular and the nucleus large and prominent. These cells group themselves together to form a thread which extends the entire length of the sponge and branches to enter the filaments as they branch, rarely doing so in the same stem. The cells apply themselves together so as to overlap one another and form with their processes a solid thread which contains no other kind of cells. In some respects these cells resemble the neuro-muscular cells of the hydra, but it is not probable that they serve the two functions here, since if they did have the power of contracting they would be prevented from so doing on account of the fact that the filaments are provided with so large a number of spicules that they cannot be contracted. From the structure, nature, position, and arrangement or grouping of the cells there seems to be little doubt that their function is that of a nervous system.

This sponge is extremely common in many lakes and streams in the Adirondack mountains, and in places completely covers the submerged trees and rocks and sends out its thousands of long, slender branches to the length of a foot or more.

Antiseptic.—Essence of cinnamon is a powerful destroyer of all kinds of disease germs. Experiments have been conducted in Pasteur's laboratory to this effect.

EDITORIAL.

Titles of Microscopical Publications.—We have been planning a card-catalogue of books, pamphlets, etc., for use in editorial work, and it has occurred to us that printed titles would be much more convenient than written. And what is useful for us might, perhaps, be also valuable for many of our readers. Can these ideas be combined in a practical manner?

As an illustration of our scheme we give on the last leaf of this number some 15 to 25 titles, with a note descriptive of the use to be made of them. There is no printing on the back of the leaf, because it is to be cut up and pasted upon cards. By carrying out this plan extensively, each person may become possessed not only of a printed card-catalogue of his own microscopical literature, but of a bibliography of the whole subject. Each month new items can be added thereto, and the matter thus kept up to date. If a dozen or more microscopists will coöperate with us in the collection of titles, it is believed that a very valuable bibliography may result. If many readers desire simply to paste up the items on cards and assort them alphabetically for reference, it will encourage the undertaking. Friends, do you want the plan carried out? The sample page is printed and this explanation made in order to elicit your views and wishes. If no one cares for it, we will let it drop. If you like the plan, please say so immediately.

Spelling Specific Names.—It is our custom, following the British Museum, the Zoölogical Society of London, *American Naturalist*, the Proceedings of the Boston Society of Natural History, and some other very reputable publications, to print all specific names with small letters, and never with a capital letter. The excuse given for the orthography *Americanum* is that the word is derived from a proper name, but perhaps a majority of scientists have come to a willingness already to write *americanum* and *canadensis*. Many such persons, however, still cling to the idea of using a capital at the beginning of all scientific names which have been derived from names of men. Such a position is illogical and a temporary makeshift. Eventually all words derived from proper names will either be spelled with capitals or will succumb to the method which we have adopted.

Our strongest reason for spelling all specific names on the same rule is that uniformity will enable those not familiar with names of plants or animals to know at a glance whether the word is generic (indicated by the capital letter) or specific (indicated by a small letter). As there are more than five hundred thousand such names in science, there is absolutely no scientist who can always tell, outside his own specialty, whether a given word indicates a generic or a specific name. It is not, then, for the

novice, simply, but for us all, that this information is to be conveyed.

We believe that the whole system of scientific naming is crude and unworthy of the name of science, but it is not in our power to change it. The idea that any old scientist or upstart student of birds, fishes, reptiles, or plants may promulgate, of his own unsupported opinion, a new species is absurd; and that he may name his supposedly new species for some man to whom he wishes to toady, for some friend who will return the compliment, for some man, scientific or not scientific, who happened to run upon the specimen, is perhaps worthy of a politician but not of any higher order of intelligence. And then, after this "scientist," be he beginner or even gray with years, has dubbed his species *smithii*, *jonesii*, *whitneyi*, *muniszechii*, *westwoodii*, *schiedermayri*, *macfarlandi*, *kennicottii*, *amphisbæna*, *weissfogii*, *janischii*, *eulensteinii*, *gründlerii*, *lindheimerii*, *hitchcockii*, *kützingii*, *beldjeckii*, etc., ad nauseam, we are asked to tell the world that these words are from proper names, when in truth we think them very improper and we wish that we could discourage such doings in the name of science. It reminds us of a whiskey shop in Washington which flaunts its sign before the eyes of all in big letters, "Smithsonian Restaurant," and yet it is so low a den that probably no officer of the Smithsonian Institution would enter it. It evidently hopes to get respectability from a name, just as some scientists evidently hope to be remembered by having their names attached to species. There are many other people, and among them are most of our contributors, who have no unworthy motives in this matter. They simply follow custom without feeling any aversion thereto. All we have to say of them is that, being all right themselves, they have got into company with others for whom a bad system is upheld. We wish therefore, while speaking very decidedly against the system, not to make any personal reflections nor to offend the most sensitive people. We apologize in advance to any one who is tempted to think that he is aimed at herein. We are opposing the plan and explaining why we think we ought not under any circumstances to begin specific names with a capital. And we wish to point out that our boasted science which is to control the world some day has things to reform as well as religion, politics, and business.

PROBLEMS.

4. **Blood Stains.**—What is the best method of resurrecting blood corpuscles from blood stains and old clots? How best mounted? H. M. F.

5. **Light for Photographing.**—I wish to photograph a honey-bee that is mounted on a $1\frac{1}{2}$ -in. slide. With 3-inch B. & L. student's objective I get too large magnification and too small a circle of light. It is about 3 inches only, and I want to use a $\frac{5}{8}$ plate. I cannot get a 4-inch objective to give any more light.—Student.

6. **Hardening Balsam and Damar.**—I have trouble with balsam and benzole, also with damar in benzole, on account of its hardening slowly. Several lots from different makes give same results. Can mild heat be used, or is there some better medium for quick work, reliable and easy of manipulation?—Amateur.

7. **Nervous System of Sponges.**—Referring to the note on page 48 regarding the nervous system of the fresh-water sponges, request is made for the titles of any or all papers that have been published on the subject.—The Editor, in behalf of J. M. S.

8. **Farrant's Medium.**—Why do dealers charge 50 cents for an ounce of Farrant's medium, or why does any one buy it of them, when anybody can make it for himself at less than 3 cents per ounce?

Picked lumps gum acacia,	.	.	.	4	drams.
Glycerin,	.	.	.	2	fluid drams.
Camphor water,	.	.	.	4	" "

Mix, let it dissolve, and strain.—F.

LETTERS TO THE EDITOR.

NOTE.—This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.

(5) **Societies.**—We are endeavoring to compile as correct a list as possible of existing microscopical societies in the U. S. I have written to all that I have ever heard of, but suspect that there are many others. As your journal goes everywhere, will you not request that the secretaries of all such societies communicate with me, giving name and location of society, date of organization and incorporation, names and addresses of officers, number of members, time of meeting, publications, library, cabinet, etc.?—George Otis Mitchell, 1034 Pine street, San Francisco, Cal.

(6) **Methods of Instruction.**—You and your readers may be glad to learn that an experiment in medical education with the

use of the microscope is proving successful in Chicago. The College of Physicians and Surgeons of this city has lately built large laboratories for its *students*. Of these three are microscopical. Each of the microscopical laboratories is fitted up for about one hundred students each. The equipment consists of 31 Leitz Stalio II, obj. 3 and 7, and nose-piece, and 31 Bausch and Lomb Continental stand, with 2-3 and 1-6 in. objectives and nose-piece. Beside these there are a few old instruments, which make altogether about a hundred serviceable stands. There are also provided 18 Bausch and Lomb microtomes for the use of students, beside the large instruments for special work of demonstrators.

The microscopes are in constant use from morning to night. As soon as one class turns them in, another class takes them out. With such large numbers as good work is done as has ever been accomplished with small classes before.

The histology, for example, includes fixing, hardening, imbedding, cutting, staining, mounting, and drawing or describing by *each student*. This is done without confusion or difficulty.

It has been necessary to resort to the most exacting system of accounting for the instruments. Only one has, so far, been injured or broken.

Our teachers of embryology, pathology, and bacteriology use higher powers—1-12 oil immersion with condenser. Only a few instruments are provided with these accessories.

The experiment of putting first-class instruments in the hands of large numbers of medical students has been successfully tried.

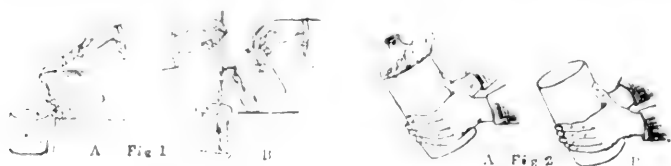
BAYARD HOLMES, *Director of Laboratories*.

104 EAST FORTIETH STREET, CHICAGO.

MICROSCOPICAL APPARATUS.

Making and Using Jars.—A very practicable method for cutting glass by which imperfect bottles can be converted into precipitating jars is illustrated in Fig. 2 (A and B). Take an ordinary bottle and tie around its body just below the shoulder a double strand of candle-wicking; then thoroughly saturate the ring of wick with alcohol by carefully pouring upon it a thin stream from the lip of a small graduate. Ignite the alcohol and hold the bottle in position shown in the figure, so that the glass above the string will be heated more than that below. When the alcohol is nearly burned out, carefully let fall upon the wick only a few drops of cold water. This method, if executed with ordinary care and promptness, will usually sever the neck and shoulders from the body of the bottle by causing a clean crack immediately underneath the string, and a precipitating jar will thus be obtained.

The advantage to be gained by employing a glass guiding rod in pouring liquids from vessels having straight sides and rim without lip is illustrated in Fig. 1 (A and B). Greasing the rim and outside surface just below the rim will also prevent the liquid from clinging to the glass vessel and cause it to flow in a full, round stream.—*Bulletin of Pharmacy*.



out lip is illustrated in Fig. 1 (A and B). Greasing the rim and outside surface just below the rim will also prevent the liquid from clinging to the glass vessel and cause it to flow in a full, round stream.—*Bulletin of Pharmacy*.

Dr. V. A. Moore's Holder for Cover-Glasses.—When sections of animal tissue are fastened to cover-glasses* in order to transfer them from one bath to another during the process of their preparation for mounting, there seems to be no reservoir in the list of histological apparatus that is well suited to their use. The ordinary solid watch-glass, crystallizing dish, etc., are objectionable, as the cover-glass falls at once to the bottom, from which it is removed with difficulty, and, again, when several specimens are being prepared at the same time they almost invariably run together in the form of *rouleaux*, the separation of which is attended with great danger to the sections. These difficulties have rendered this otherwise very convenient method of handling sections, when from their nature a support is necessary, so objectionable that the cover-glass is seldom used by histologists for this purpose. The following apparatus is for holding the cover-glass during the hydration, staining, dehydration, etc., of the sections, and has been found to work admirably:

The apparatus consists simply of a "double dish" 15 centimeters in diameter and 2.5 centimeters in depth, in which glass rods are arranged parallel to each other and separated by a distance of about 4 millimeters. The rods are about 5 millimeters in diameter. They are raised about 2 millimeters from the bottom of the dish and fastened only at the extremities, thus permitting of a free circulation of the liquids. The cover-glasses are placed on edge between the rods, against which they rest (Fig. 1). A res-

* In fastening sections to cover-glasses care must be exercised in the choice of some method of fixation which will not leave a film on the cover that will be tinted to any degree by the stain used. The gelatin, albumen, and collodion processes are not always satisfactory when certain aniline dyes are subsequently employed. A method which seems admirably adapted to this process of handling sections is the paraffin-alcohol method described by Dr. A. Canini in the *Archiv. f. Anat. u. Phys., Phys. Abth.*, 1883, p. 147. It consists simply in placing the section on a cover-glass directly from the section-knife and adding a few drops of dilute alcohol (60 to 70 per cent.). The cover is then placed in a paraffin oven at a temperature of about 50° C., where it remains until the alcohol is evaporated. This method was also highly recommended by Ogata in his work on the pancreas cell. It is applicable only to sections cut by the paraffin method.

ervoir of this size will hold, without crowding, thirty preparations on $\frac{3}{4}$ -inch covers. It is desirable to have a reservoir for each of the liquids used. The cheapness with which they can be made does not render this objectionable.

The construction consists in procuring the desired number of "double dishes," a few feet of glass rod, and an ounce or two of liquid glass (silicate of soda) or a few feet of fine copper wire. The glass rod is easily broken, by the aid of a file, into pieces of the required length, which are fastened in their respective places by means of a few drops of the liquid glass. In order to raise them from the bottom of the dish a ring composed of the liquid

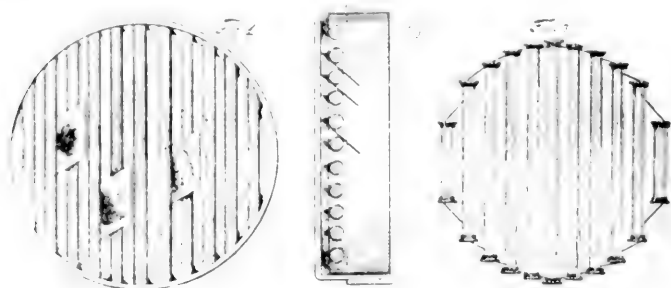


Fig. 1—Cover-glasses in position. Fig. 2—Cross-section. Fig. 3—Mat of glass rods.

glass is built up around the edge, upon which the ends of the rods can rest and upon which they are fastened. As the silicate of soda is soluble in water and dilute alcohol, it is necessary to dehydrate it after the rods are fixed, so as to render it insoluble. This can be done by heating the reservoir in an oven or hot-air chamber at a temperature of about 98° C. If the reservoir is to be used only for turpentine, absolute alcohol, etc., the drying of the silicate of soda in the air is sufficient.

Instead of fastening the rods in the dish they can be bound together by means of fine wire, preferably copper, in the form of mats, which answer every purpose and which can be removed at will if the dish is desired for other purposes. This is easily accomplished by running the wire around the ends of the rods after they have been cut the desired lengths. A shoulder-like projection can be procured on the ends of the rods by heating them until soft and pressing them against a firm surface. These prevent the wire from slipping off, and also raise the rods from the bottom of the dish (Fig. 3).

With a full set of these reservoirs thirty cover-glasses can be carried from the first to the last liquid quite as quickly as a single

preparation, for the time necessarily required for the action of the various reagents on a single specimen can be profitably employed in transferring other preparations. The cover-glasses can be handled very quickly, neatly, and with perfect safety with a pair of fine forceps.—*Proc. A. S. M.*

MICROSCOPICAL MANIPULATION.

To Find the Refractive Index of Various Mounting Media.—E. M. Nelson has given the following to the Quekett Club:

Provide two precisely similar equi-convex lenses whose identical refractive index, m , and radii, r , are known, and cement them together with the mounting medium, whose refractive index has to be determined. Now measure F , the principal focus of the combination, then the refractive index of the mounting medium.

$$m' = 2m - 1 - (r \div 2F).$$

It is convenient to make the radii of the lenses 2 inches. Then,

$$m' = 2m - 1 - (1 \div F).$$

For example, let the refractive index $m = 1\frac{1}{2}$; suppose the combination to have no focus (like a piece of plane glass), then $F = \infty$, and $1 \div F = 0$. Therefore

$$m' = 2m - 1 = 2.$$

Let $F = +2$ and we shall have the following result, which is the same as that of the equi-convex lenses:

$$m' = 2m - 1\frac{1}{2} = 1\frac{1}{2}.$$

If the principal focus of the combination F is negative the sign before the fraction changes. Let $F = -2$; then

$$m' = 2m - 1 - (1 \div -2) = 2\frac{1}{2}.$$

This method gives a great range of readings for indices varying between 2 and $2\frac{1}{2}$.

Heidenhain's Modified Micro-technical Methods.—Prof. A. Ohlmacher (*Medical News*) describes Heidenhain's method of preparing animal tissue for study. The process consists in fixing in corrosive sublimate, dehydrating in alcohol, clearing in bergamot oil, and imbedding in paraffin.

The fixing solution is made by saturating a $\frac{1}{2}$ per cent. solution of common salt in distilled water, with corrosive sublimate. The solution should be supersaturated with sublimate. Cubes of tissue, three-eighths of an inch on the edge, are dropped in some of this solution. A half-hour to an hour's immersion is sufficient for perfect fixation. The object is then brought directly into 95 per cent. alco-

hol. After twenty-four hours the tissue is ready for cleaning, for which bergamot oil is used. The object remains in this from two to twenty-four hours, according to size, when it is removed to a bath of equal parts of soft paraffin and bergamot oil, kept at the melting point; then to paraffin which melts at 45° C., where it remains from one to two hours. The object is now removed to paraffin which melts at 58° C.; after remaining from one to two hours it is finally imbedded. The sections are now cut with the microtome, and fixed upon the slide by the modified method of Gulland. A drop of water is placed on the slide over the surface to be occupied by the section. The slide is then warmed but kept below the melting point of the paraffin in which the object is imbedded. The section is placed on the drop of water, where it at once flattens perfectly; the excess of water is removed by blotting-paper; the slide is kept warm until the water has evaporated. The paraffin surrounding the section is then cautiously melted. The slide is placed in xylol or benzine to remove paraffin, and is then placed in 95 per cent. alcohol, where it remains from an hour and a half to six hours. The sections are now treated with pure tincture of iodine in order to remove the excess of corrosive sublimate; the tincture is allowed to act for about fifteen minutes; the slide is then placed in 95 per cent. alcohol, where it remains until no more iodine dissolves out of the section, which is then ready for the stain.

The sublimate fixing solution is spoiled by contact with metallic substances, and tissue fixed in it becomes brittle if kept long in alcohol. The disadvantages may be overcome by using glass or wooden rods for transferring objects to and from the solution, and by imbedding early.

Detection of Frozen Meat.—The process adopted by the author for distinguishing between fresh meat and that which has been preserved in the frozen state consists in expressing a little blood or meat juice from the sample and examining it under the microscope. The whole operation must be performed quickly, in order to prevent any drying up of the liquid under examination. When the juice of the fresh flesh is thus examined it is seen to contain numerous red corpuscles, which are normal in color, and float in a clear serum. In the case of blood from frozen flesh, the corpuscles have dissolved in the serum under the influence of the low temperature, and not a single normal red corpuscle can be seen. The hæmoglobin escapes into the serum, and appears as irregular yellow-brown crystals. These may be frequently seen by the naked eye, but, in every case, can be readily detected under the microscope.—*Maljean, in J. Pharm. Chim.*

Cleaning Bottles.—Greasy bottles: Wash with benzine or with a solution of permanganate of potash to which has been

added some concentrated hydrochloric acid. The disengaged chlorine destroys the fatty matter, which then disappears by washing in water. Bottles that have contained resinous substances: Wash with potash or soda and rinse with alcohol. Bottles having contained essences: Wash with sulphuric acid, then with water.

BIOLOGICAL NOTES.

Bees in Cold Weather.—A colony of bees rarely dies from cold, but it may be weakened very seriously if proper precautions are not taken. Fully as important as warmth is dryness; dampness in the hive will work much mischief, and it should be seen that the hive is dry, and kept in a dry place. Frequently in cold weather sudden gleams of sunshine tempt the bees out of their hives in great numbers, when they become chilled, fall to the ground, and, being unable to regain the hive, perish. The sun shining upon snow appears to be a special temptation to bees to leave the hive. The zig-zag entrance provided to some frame-hives is most effectual, on account of its form, in preventing the rays of the sun entering.

Rapid Multiplication.—Bacteria, in a barrel of sweet apple-juice, propagate at such a rate that were the visible universe a barrel of apple-juice, these micro-organisms would fill it, 12,000,000 of them in every cubic centimeter.—*Stephens.*

DIATOMS.

A New London Dealer.—We have received from Barbour Bros., Cromwell House, London, two of the neatest slides which we have ever seen. They consist of diatoms, the first, *Aulacodiscus margaritaceus*, from Peru, and the second, *Coscinodiscus diorama*, from San Redondo, Cal. They were sent to us in a fine morocco case, and got into the country without any question being raised by the customs people. We understand that the Barbour Bros. sell a great many of these slides at \$2.25 per dozen in England, and we see no reason why they should not sell here also, if properly catalogued and advertised.

First-class slides used to sell in this country at a considerably higher price than this—perhaps too high to induce many sales. About this price, which is less than 20 cents each, no one can complain. In lots of 144, the price of which is £4 sterling, they come at only 13½ cents each. We shall be glad to see the catalogue of what Barbour Bros. have for sale.

BACTERIOLOGY.

Staining the Capsules on the *Micrococcus Lanceolatus*.—Prof. Welch (*Johns Hopkins Hospital Bulletin*, III (1892), p. 125) has described a new method for staining the capsules on the *Micrococcus lanceolatus*. It is as follows: Cover-glass preparations made without water from the tissues of rabbits or other experimental animals dead from the inoculation of this germ are treated first with glacial acetic acid, which is at once allowed to drain off and is replaced (without washing in water) with aniline-oil, gentine-violet solution. The staining solution is repeatedly added to the surface of the cover-glass until all of the acid is displaced. If now the specimen is washed with a saturated aqueous solution of the common salt and is examined in this solution, it will be seen that both coccus and capsule are uniformly and deeply stained and cannot be differentiated. If water be used instead of saturated salt solution, the capsules are decolorized, sometimes only in part when they can be clearly recognized, but often completely, and they may entirely disappear. By using weak solutions of salt it is possible in all cases to differentiate the capsule if it is present. The strength of the solution best adapted to different cases varies. Often the ordinary physiological solution suffices. A generally useful strength is two per cent. The specimens are to be examined in the salt solution. When mounted in balsam the capsules do not always remain distinct. The capsules may appear stained throughout, or only their outer margin may be stained. This method of staining was worked out on the supposition that the capsules are composed essentially of mucin, which is precipitated by acetic acid, and when thus precipitated is insoluble in concentrated salt solution and swells up in water. The chief advantages of this method are the difficulty of avoiding precipitates of the dye, and the alterations in the cells and other elements, but in difficult cases it will serve a useful turn, although less violent methods when applicable are to be preferred.

The capsules vary in their structure, some being much more delicate and narrower than others. In old exudates the capsules are often very distinct and resistant to the action of water, in which they may appear even quite highly refractive. The *Micrococcus lanceolatus* stains readily on cover-slip preparations with the ordinary aniline dyes. It is less easily stained in sections. In these it can be stained by Gram's method, but Weigert's fibrin stain gives better results. The number of cocci brought to view by this last method in sections of human lungs affected with lobar pneumonia is often very great, and the presence of the majority of the cocci inside of leucocytes is clearly demonstrated.

Some Facts about Lustgarten's Method for Staining •Syphilis Bacilli.—M. Sabouraud (*Annales Inst. Pasteur*, 1892,

p. 184), after having frequently failed to find bacteria in syphilitic products by Lustgarten's method, lighted on a case of ulcerating gumma, in the pus of which he succeeded in demonstrating by Lustgarten's method some bacilli. These bacilli were not stained by Ehrlich's method. The author therefore presumes that he has found the bacilli of syphilis. But a guinea-pig having been inoculated with this pus died of tuberculosis.

The author then raises the question whether Lustgarten, who did not make any inoculations on guinea-pigs, may not have been mistaken in the true character of the growths. Indeed, it was found that Lustgarten's method was extremely useful for demonstrating tubercle bacilli, especially in the liver. The author gives a new method for preparing sulphurous acid solutions.

MEDICAL MICROSCOPY.

The White Corpuscles as Protectors of the Blood.—Dr. Werigo, when examining under the microscope, the blood of a rabbit which he had received some minutes before, an injection of *B. prodigiosus* in the auricular vein, was surprised to find the blood almost destitute of leucocytes. He repeated the experiment with the same result, and became convinced that the phenomenon was constant. In order to prove this, he made a series of experiments in which he injected cultures of different microbes into the blood, counting the leucocytes before and afterward. The main fact brought forward receives the following explanation: The leucocytes disappear from the blood under the above-named circumstances because, when they have engulfed the microbes injected (which they speedily do), they are arrested in the organs, especially in the liver, where they pass on the ingested material to the endothelial cells of the organ. The rapidity with which the microbes become enclosed in the leucocytes is most astonishing; it is far greater than we have been accustomed to suppose. It is not the leucocytes alone, however, which undertake the clearance of the microbes from the blood, for the cells of the spleen pulp, and also the endothelial cells of the liver, take no direct phagocytic functions. The author's researches also lead him to consider that the first event after the injection of any microbes, of whatever virulence, is their inclusion in cells.—*The British Medical Journal*.

MICROSCOPICAL NOTES.

The Tariff.—We await with some anxiety the removal by the new administration of the duty on microscopes, medical and

surgical instruments, and scientific books. Putting these on the free-list will be of much benefit to physicians.—*Lancet Clinic*.

Peroxide of Hydrogen.—The Drevet Manufacturing Company, of 28 Prince street, New York, will send to any one desiring it a circular containing a full and complete answer to certain criticisms recently made by a New York physician upon the character and effects of the preparations of peroxide of hydrogen manufactured by them. As peroxide of hydrogen possesses undoubted medicinal properties, this reply will be read with interest by members of the medical profession.

Too Much Business.—Please discontinue my exchange notice, as an unlooked-for number of responses have already exhausted my supply.—H. C. F.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.—Geo. Otis Mitchell, Sec'y.

Wednesday, Feb. 1, 1893—Annual Meeting.—After the routine business, which included the election of three new members and the receipt of proposals from three others, the reports of the retiring officers were read. The financial statement of the treasurer, Charles C. Riedy, showed a good balance on hand, after the expenditure of several hundred dollars for additions to the library and for other property. George Otis Mitchell, the corresponding secretary, read a statement of the various matters undertaken by him, the chief of which was putting the society in closer relations with all kindred societies and compiling a list of them with the date of their founding.

President Breckenfeld then read his annual address, which reviewed the work of the society for the past year. He said the year had been the most prosperous one in the history of the society, and the unabated interest in the meetings was evidenced by the attendance, which had been larger than ever before. The papers read and the addresses made at its various meetings had been of exceptional value. The library, the pride of the society, he said, had been considerably augmented, not only by valuable donations and extensive purchases, but by binding up and making available the mass of periodical and pamphlet literature. So numerous had been these additions that the president suggested the rearranging and recataloguing of the entire library.

The cabinet of slides and materials has been largely increased, and the work-room and laboratory have had many additions, increasing their efficiency. The paper also mentioned the plan of holding conversational meetings, when invitations had been sent and responded to by large numbers of persons, whose interest in

science, and especially in microscopy, had been very much aroused. These meetings and informal exhibitions will be continued in the future. He also spoke of the numerous excursions and "field days" had recently, always productive of good results.

This retrospective glance, he said, showed that the year had been one of earnest endeavor, and had at least resulted in making membership in the society more practically helpful and genuinely enjoyable than ever before. The rapidly spreading use of the microscope in so many directions is in itself a reason for the society's existence, though not the only one. The study is a many-sided one, and has its intensely practical side, as the detection of crime and forgery, and the working out of the great biological and pathological problems of the age.

After the conclusion of the annual address the society proceeded to an election of officers, when all the old officers were re-elected except the vice-president. The officers for the ensuing year are: President, A. H. Breckenfeld; vice-president, Dr. Douglass W. Montgomery; recording secretary, William E. Loy; corresponding secretary, George Otis Mitchell; treasurer, Charles C. Riedy.

BUFFALO MICROSCOPICAL CLUB, BUFFALO, N. Y.

Monday, Nov. 14, 1892.—Meeting held in the library building. Exhibition was made of the embryology of the chick. G. Carl Hauber, M. D., of the University of Michigan, read a paper entitled "The Use of the Microscope in the Diagnosis of Diseases of the Blood."

LINCOLN, NEBR., MICROSCOPE CLUB.—Roscoe Pound, *Sec'y.*

December 27th.—No meeting was held on account of the meeting of the Nebraska Academy of Sciences on that day.

Tuesday, January 31st.—The following officers were elected for 1893: President, A. F. Woods; vice-president, F. C. Kenyon; secretary, Roscoe Pound; treasurer, J. S. Dales; members of the executive committee, E. T. Hartley and Dr. H. B. Lowry.

OMAHA MICROSCOPICAL SOCIETY.—George Wilkinson, M. D., *Sec'y.*

This society was organized March 17, 1892, and for some time held regular weekly meetings, but at present meetings are rarely held. For 1893 the president is Irwin Leviston. There are twenty members, most of whom work constantly with the microscope. On February 15th Prof. Lighton exhibited some of their mounts before the Omaha Medical Society. The society has no library and but little other property. It is not incorporated and has no printed constitution. Its meetings used to be reported in the *Omaha Clinic*. The secretary for 1893 is Geo. Wilkinson, M. D., Karbach Block, Omaha, Nebr.

QUEKET CLUB, LONDON, ENGLAND.

Friday, Dec. 16, 1892.—The president, Dr. Dallinger, held the 307th regular meeting at 20 Hanover Square.

The secretary announced that the *Journal* will hereafter be published in March and October—price raised to 87 cents per number. Officers for the year will be elected January 20th.

Prof. W. C. Williamson, LL.D., read the paper of the evening, on "Mineralization of the Minute Tissues of Animals and Plants." He discussed the chief features of the process of fossilization taking place in various orders of animals and plants, and the manner in which their skeletal or protoplasmic tissues are replaced by calcium carbonate, silica or iron sulphide, and gave many illustrative instances occurring in several geological formations. A large series of microscopical sections and specimens were exhibited.

NEW PUBLICATIONS.

Biennial Report of the Alabama Insane Hospital for two years, ending Sept. 30, 1892. Montgomery, Ala. 1892, pp. 104.

From this report, which Dr. Bondurant, the pathologist, has kindly sent to us, it appears that during the past 18 months some 92 autopsies have been held. Organs and tissues showing disease have been subjected to subsequent microscopic study, or in many instances preserved entire. Microscopic slides to the number of about 2,000, chiefly animal tissue, normal and diseased, have been accumulated.

In a series of autopsies the pathologist has made microscopical examinations of the kidneys, and has reported the results obtained in each of the 44 cases. There was always something abnormal found about the kidneys. The astonishing statement is made that some form of Bright's disease has been found in at least one-half the insane persons brought to this hospital for treatment.

The kidneys were prepared for microscopic study by hardening in Mueller's or Fleming's fluid or in dilute alcohol. Sections were cut by the ordinary imbedding methods and examined unstained. They were also colored by the usual nuclear stains as well as by the aniline dyes. For the demonstration of amyloid degeneration, both iodine in solution and the acetic acid—gentian violet method was employed. Sections were in every instance made from both kidneys. Postmortem changes in the cells of the kidneys were always considered and avoided as much as possible by making early autopsies.

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Biological Descriptions of Certain Common Hydroid Animals.

By H. L. OSBORN,

ST. PAUL, MINN.

[WITH FRONTISPIECE.]

In the chapter on the Protozoa (*A. M. M. Journal*, 1892) it was shown that a great variety of animal form is possible by varying the form of a single cell and its different parts, but none of the Protozoa attain any considerable size. Now, in the competition of animal life size is an advantage to its possessor, other things being equal. Any very considerable increase of size is impossible in a single cell, because, as pointed out by Herbert Spencer, the solid capacity outruns the surface area, and thus, in increasing sizes, the points where food can be taken in soon become too few for the bulk. Hence, to secure the advantages of size, cells are forced to club together and form multicellular bodies. We find in the cœlenterate animals the simplest type of multicellular bodies, many of which are easily accessible to large numbers of students, and this present article is written as a key to the cellular structure of some of the representative members of the group. As many of the readers of this *Journal* live near the ocean or visit it during the summer, I trust they will find it possible to verify upon specimens they can find some or all of the points I shall speak of.

HINTS FOR PRACTICAL STUDY OF HYDROZOA.

A great deal can be done in the study of these animals at very little cost for appliances, but, of course, the best work requires skill and patience and a good compound microscope.

First, in collecting specimens of marine Hydrozoa from a boat or when in bathing, examine submerged sea-weed or scan carefully the submerged portions of objects such as piles of wharves, floats, buoys, drift-wood, and remove with knife parts which appear to promise well, placing the material thus obtained in a tumbler with plenty of sea-water. Give it time to recover from the stimulation you have caused, and if there be any living hydroids in your capture they will presently reward you by expanding; or

instead of collecting from such sources you can examine carefully and under water shells and stones, etc., raked or dredged from deeper levels than you can reach and you will find other objects. Hydra is found in the same way in fresh water, and is the only hydroid likely to be found there. It is possible to mistake Bryozoa or Polyzoa for Hydroids, but you can easily distinguish by reference to a text-book of zoölogy.

Second. Specimens should be kept alive several days in the laboratory and observed from time to time. Each kind should be kept separate and a few in each glass, not having enough to foul the water perceptibly. The water should be changed at least once a day without uncovering the specimens, which are too delicate to endure exposure to the air without injury. Small portions of the colony, or single zooids, should be placed in a watch-glass in sea-water and examined with low power. It will be possible thus to catch the gonozooids in the act of escaping from the parent Hydroid stock. If single zooids be mounted on a slide in sea-water and covered with a cover-glass, many points in their structure can be seen with a quarter-inch objective, including the circulation of food in radial and circular vessels of medusæ, and the nettle cells; the working of the latter can also be demonstrated in the act. For direction for preserving and sectionizing hydrozoa the reader should consult some of the many guides for such work.

1. HYDRA FUSCA* (figs. 1 to 16).

Unlike most coelenterates, *Hydra* is not a marine animal, but lives in warm and sluggish fresh waters. It is generally attached to aquatic plants. It is a translucent brownish body, $\frac{1}{4}$ inch long, a flexible hollow tube fastened at one end, the base, and terminated at the other with a conical *manubrium*, in the centre of which is the mouth. The margin of the manubrium bears several tentacles, long filaments which are in constant wavy motion. In the autumn the tubular body may bear small warty prominences, which are the gonads or reproductive organs; ovaries nearer the manubrium, and spermaries nearer the base.

The living *Hydra* not only moves its tentacles, waving them to and fro, or extending and shortening them, but can do the same thing with the tubular body, and it is thus able to become very large and long and narrow, or to shorten up into a round speck not much larger than a pin's head. It will do this if it is rudely touched, as with a needle. It sometimes leaves its point of attachment and creeps about in the water on its oval end or on its side, and it very persistently seeks the lightest side of any vessel in which it is confined.† If any minute animal (e. g., Ostracod or

*BIBLIOGRAPHY OF HYDRA.—**Parker, *El. Biol.*, p. 209. **Howes, *Biol. Atlas.* Huxley and Martin, *Practical Biol.*, p. 343. **Lankester, *Encyc. Britt.*, vol. xii, p. 561. Packard, *Text-Book Zool.*, p. 52. Haddon, *Pract. Embryol.*, pp. 1-15. Carpenter, *The Microscope*, p. 76. A. M. M. Journal, iv, p. 223; iv, p. 64. vii, p. 221. Kleinenberg, *Hydra*. **Riverside, *Natural History*, vol. i, article Hydroids.

† See Heliotropism, E. B. Wilson, *American Naturalist*, vol. 25, 1891, p. 413.

Cyclops) comes in contact with a tentacle it is at once paralyzed, and the tentacle bends with it toward the centre of the manubrium, whereupon the mouth opens and the prey is swallowed. Hydrazes often swallow a prey larger than their own body, so that the tube is greatly bulged out. After a certain period the shelly remains of the digested prey is pushed out through the mouth, one opening thus serving as both mouth and anus. Some specimens of Hydra, but not all, have one or more buds or smaller specimens, more or less like themselves, attached to the sides of the tube, of varying ages, from fully formed ones to the least perceptible swellings. These subsequently break loose from the parent body and grow to the paternal size and bud in their turn. Hydra thus grows, feeds, moves, feels, and reproduces. What animal can do more?

If Hydra be killed, preserved, and prepared after microscopical methods and sectionized, its structure stands revealed. It is shown in figures 2 and 3, both being somewhat diagrammatic; fig. 3 less so.

It is composed of two distinct layers, an outer, *ectoderm*, and an inner, *endoderm*, bounding a central cavity, the stomach cavity. These layers are composed of multitudes of similar units, each one a *cell*, being a bit of protoplasm with a nucleus, but no contractile vacuole, and a thin outer wall, and hence comparable with a protozoan. The cells of the ectoderm are smaller than those of the endoderm. They cover the body in every part, including the tentacle, manubrium, stopping short at the mouth, and also run under the base, so that any part of the body which could come in direct contact with the water has an ectodermal covering. The deeper ends of the ectoderm cells are drawn out into long motile processes which are contractile, and it is by the aggregate actions of these in various directions that the motions of the body or tentacle are produced. The ectoderm in theoretical section is illustrated (fig. 15) after Von Lendenfeld.*

This shows it to contain peculiar structures, called nettle cells† or nematocysts, which contain a small sack filled with poisonous fluid and furnished with a dart and a long hollow tube for conveying the poison into any body which may be pierced by the dart.

The cyst is surrounded by protoplasm whose contraction is excited by the sensitive hair at a greater or less distance, excited in turn by contact with a foreign object. The ectoderm, besides containing these muscular and nettle cells, is made up also of simple columnar cells and of glandular cells, and its outer edge presents a peculiar cuticular appearance, as if harder than the rest, forming a sort of cuticle to protect the softer protoplasm beneath (Fig. 5). The endoderm lines the body internally throughout (cf. fig. 2), including the tentacles and the buds, but it will be noticed that the gonads are thickenings of the ec-

* 2. Jl. Micros. Sci., Jan., 1887; also Am. Nat., 1887, p. 289.

† E. B. Wilson. See this Journal, vol. ix, p. 79.

toderm only. The layer begins at the summit of the manubrium, there being no ingrowth of the ectoderm, as in some of the Cœlenterata, to form a throat. The endoderm and ectoderm are separated by a non-cellular layer, called the *supporting lamella*, and there is no considerable space between them, nor any foldings in the endoderm, but it everywhere lies in direct contact with the ectoderm. The endoderm cells of the stomach cavity (see fig 5) are large vacuolated cells with nucleus, and drawn out into long flagella or pseudopodia, or both, and the food is taken by engulfing, and can be seen in the outer end of the cell, or in some sections has been even caught in the act of being engulfed.

Zoölogists of the present day regard Hydra as a community of cells comparable with Amœba or other protozoa, which, by being banded together and dividing the work of the community among various sets of cells, make the body of the size and powers of Hydra a possibility. The parceling out of the vital functions has been along two lines, the functions of alimentation, or working the food into usable shape chemically, being assumed by the endoderm, and the functions of sensation and motion, so necessary to the discovery and capture of food, as well as to the general care and well-being of the cell-whole, being the work of the ectoderm. Such a division is called a division of physiological labor, and it is understood that the building up of higher and better animal bodies is not possible except as this principle is more and more perfectly applied in the construction of bodies. While in dividing labor some of the functions of the primary unspecialized cell are set aside and others are more highly specialized, some of the primary functions are always retained, viz., the power of nutrition or of controlling chemical laws and the power of cell reproduction by division. This conception of the body of Hydra as a colony of cells introduces a new conception of the nature of an animal's individuality or personality. If in Amœba and the Protozoa we consider each single cell a person, why not so here? Our idea of personality, however, was formed before we knew of the cell doctrine, and we shall hence have to notice that in our idea of the personality of Hydra we have to do with a different order from that we see in Amœba, it being, in fact, some of the united personalities of the individual cells. It is not, therefore, possible to compare Hydra as a whole with a protozoan, but we must compare its cells with Protozoa to get satisfactory ground for biological studies.

The life-history of Hydra bears out this conception of it as a colony of cells. The gonads* are composed of cells which have specialized the function of cell division, but in two very different ways, viz: in the production of *ova*, and in the production of *spermatozoa*. Hydra can reproduce itself by budding, a portion of the ectoderm and endoderm growing out to form a miniature Hydra, which gradually attains full size and reproduces in turn in

* See Gieddes, E. Britt, xx, p. 497, Art Reproduction; also, Evolution of Sex.

the same way. This is termed "asexual development." Any part of Hydra has the power, if severed, by accident, from the body, of reproducing all the rest of the body, and thus the more you lacerate and cut up such a body the more Hydras you produce. But, besides these asexual modes of reproduction, Hydra has the power, resident in the gonads, of producing a wholly new body from the combined product of a single ovum and a single spermatozoon; this process is called "sexual reproduction." Its steps are as follows: The ovary is composed of angular cells, primitive ova; these are amoeboid within the ovary, and they struggle for life, the stronger devouring the weaker, till finally one large egg-cell, *ovum*, results (fig. 6), which consists of a nucleus and protoplasm, and a large amount of food-yolk, called *deuteroplasm*, which is of a fatty nature and is destined to serve as food for the growing ovum. The cells of the male gonad, or *spermery*, take an opposite course, dividing and redividing to form mother cells of spermatozoa (see fig. 7), which become at first amoeboid, then globular, then thrust out a long flagellum, and finally shrink to a minute head on the end of this flagellum. Myriads of immensely active spermatozoa striking their tails about burst from the spermery and, moving vaguely, swim through the water, and some find the ovum in the female gonad, or ovary. The ovum undergoes its earlier changes in the ovary. Before the advent of the spermatozoon, it has assumed a spherical shape, the nucleus has travelled to the margin, and some of its substance passed out of the wall of the ovum in the form of two minute droplets—*polar globules*. The spermatozoon enters and a second nucleus forms about it, and the two nuclei then fuse to form a single completed nucleus, and this act is called the fertilization of the egg. It is necessary to the future development of the egg, for otherwise it does not segment; the formation of polar globules is regarded as a sort of feeble attempt to segment.

Immediately after fertilization the ovum *segments* or divides into two cells in a manner precisely like the division of a protozoon, but the cells remain connected; it does not stop here, but presently each half divides into quarters, and these into eighths. The cells keep on dividing, and form a mass of 16 cells, 32 cells, 64 cells (see figs. 8, 9, 10, 11, 12), until finally they have grown to the form of a hollow sphere of many cells, but only one cell thick, called a *morula*, the cavity within being called the *segmentation cavity*.*

This segmentative activity pushes the sphere out to a certain size, after which new cells as they are formed are pushed in, or push others into the segmentation cavity until a solid *morula* is formed. The cells thus pushed in are the endoderm, and those remaining on the surface of the sphere are the ectoderm. The

* Brauer, Zeits. f. u. Zool., vol. 52, page 169, 1891.

body, by constant addition of cells, changes its external shape from a sphere to a tube, and one end grows by degrees into the form of Hydra, with manubrium and tentacles (fig. 14). Meantime the endodermal cells struggle for life; some are devoured by others, and the food they yield nourishes the whole colony. Their removal leaves a space in the centre, and the mouth being formed, food is captured by the tentacles, forced into this space, and the endoderm cells receive supplies, which relieve them of the necessity of cannibalism. The course of this history of Hydra receives usually an interruption. The first part of the development takes place in the autumn; the egg, covered with a tough secretion, remains dormant during the winter, its development being renewed by the warmth of spring, when the young repeople the pond, its parent having succumbed to the severity of the winter.

(In *Limnocoladrium*, a fresh-water animal allied to Hydra, there is a true medusa (see *Am. Mo. Micro. Jul.*, vol. iv, p. 223), but in Hydra the gonads are understood to represent degenerate medusa stages.)

EXPLANATION OF THE FIGURES OF HYDRA FUSCA.

(SEE PRONTISPIECE.)

Fig. 1. Surface view of partly contracted specimen, showing bud. (b), tentacles (ten), manubrium (mn), ovary (ov), and spermary (sp).

Fig. 2. Diagrammatic longitudinal section, ectoderm cells not shown (ec); endoderm, its columnar cells granular from food in ends toward stomach cavity, running up into the tentacles and out into the bud; supporting lamella (sl). Note the absence of any infolding of the ectoderm to form a throat (compare *Scapanemone*).

Fig. 3. Cross-section of one-half of body from nature, showing the smaller ectoderm cells and larger endoderm cells, granular at the end next the cavity and the supporting layer.

Fig. 4. Isolated ectoderm cells, after Kleinenberg,* showing the contractile processes next the supporting lamella.

Fig. 5. Section of body wall, partly after Schultze (E. Britt., ix, p. 549), showing the ectoderm with the cuticular border and the included *nematocysts* and glandular cells, and the large vacuolated endoderm cells with amœboid and flagellated outer ends and engulphed particles; sl, supporting lamella.

Fig. 6. Ovum ready for development, showing the pseudopodial processes and the granular deuterooplasm and the nucleus (after Balfour, *Comp. Emb.*, i, p. 17).

Fig. 7. Stages a, b, c, d, e, in the development of spermatozoon (after Kleinenberg).

Fig. 8. Egg after fertilization.

Figs. 9, 10, and 11. Successive stages of segmentation.

* See Gegenbaur, *Comp. Anat.*, p. 30; also E. Britt., ix, p. 549.

Fig. 12. Morula stage.

Fig. 13. Section of morula, showing the beginning of the growth of the endoderm.*

Fig. 14. Gastrula stage of Hydra (Kleinenberg).

Fig. 15. Diagram† to explain the physiology of nettle-cell, showing the ordinary columnar cells, the supporting lamella (sl), the pillar from it to the nettle-cell, the muscular layer (mu), the protoplasm of the nettle-cell surrounding the elastic sac, and a fibre running thence to the sensitive hair cell (sen).

Fig. 16. Nettle-cell with thread ejected (from nature).

(*To be continued.*)

· Radiolaria.

By REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

In the number of the JOURNAL for last November my series of articles on the "Radiolaria: their Life-History and their Classification," came to an end. But that simply means that the task I had set before myself in the summer of 1891, and which resulted in the paper which formed the bulk of those articles, was finished. It was my aim to give a brief account of the life-history of this class and a general idea of the classification of the genera found by Ehrenberg in the Barbadoes earth, taking Haeckel for my guide, and I carried out my aim as well as I could. But I would not have the readers of the JOURNAL suppose that I have done with this subject. On the contrary, I feel that my work has only just begun, and I shall hope to bring the Radiolaria before the microscopists of this country again and again, for I am more convinced than ever that these forms are worthy of the closest study, and that any one who will devote himself to this subject will become as enthusiastic as myself. And there is a special reason why he should take it up, for, as far as I can discover, there are few workers in this country who are paying any particular attention to it. The number of those who are studying the diatoms is legion, but you can count on your two hands—yes, on one hand, unless I am very much mistaken—the microscopists in the U. S. who are giving all the time at their command to the Radiolaria and pursuing this branch with the settled intention of mastering it as far as possible. As yet, I have not heard of one such, and I would most earnestly beg any worker in this line to make himself known to me. There is work enough for a score of others. In the November number of the JOURNAL Mr. K. M. Cunningham pleads for a distinct science, to be known as "diatomology," and gives three reasons why the study

* Brauer, Zeits. f. u. Zool., vol. 52, p. 169; pl. x, fig. x12.

† See Von Lendenfeld, Am. Nat., 1887, p. 289.

should have such a distinctive title. Now, those three reasons apply with almost if not quite equal force to the Radiolaria. It is just as true of the Radiolaria as of the Diatomaceæ that, to quote his words, they "can become the basis of one of the most impressive, instructive, and engaging branches of pure science that may occupy the attention of the human mind.

"Firstly, on account of its power in gratifying the purely natural impulse inherent in the mind to be impressed with whatever is beautiful in nature.

"Secondly, from its being a legitimate line of research independent of the merely beautiful, practical, or pecuniary.

"Thirdly, the study . . . from merely an observational point of view, whether in relation to their place in nature, what role their creation was intended to fill in the economy of nature or of earth-building, and their biological functions, . . . is capable of drawing forth the highest and best efforts of mental genius, erudition, and the power of the judicial and critical qualities in bright minds, in dealing with the numerous problems suggested by repeated and lengthy association with their investigation. A field of human effort is here offered well worthy of capable minds."* And a field, mind you, which on this side of the water has not, to my knowledge, been worked at all. If Leidy did not think it beneath him to devote himself to the fresh-water rhizopods, why should any one scorn their marine relations? If he were to confine himself to the Barbadoes deposits alone he would then have more genera to consider than Leidy described—considerably more, for the genera of the fresh-water rhizopods as given by Leidy only number 30, but the genera of the Radiolaria of Barbadoes as described by Ehrenberg number 42, or as classified by Haeckel, 56, nearly twice as many. I have already mentioned the fact that Ehrenberg found 282 species in that earth, that Mrs. Bury added 141 more, and that Haeckel says the list is not ended yet, but that the total number of species in that deposit alone is probably over 500. Are not they enough to begin on, especially as there is a chance of discovering nearly 80 new species? And here let me say, for the encouragement of others, that I have already found a large number of those given by Ehrenberg, and quite a number that are not figured by him. I worked at that material all summer and picked out and mounted on type-plates nearly 500 forms. Many of these proved to be duplicates, and quite a number, as I have said, were not in Ehrenberg; but here is the list of those I was able to identify.

Cenosphæra micropora.
Stylosphæra liostylus.
 sulcata.
 lævis.
 coronata.
 flexuosa.
 spinulosa?

Spongosphæra pachystyla.
 rhabdostyla.
Haliomma sol.
 nobile.
 apertum.
 contiguum.
 umbonatum.

* Amer. Mo. Mic. Jour., Nov. 1892, pp. 249-250.

- Haliomma echinatum?*
 triactis.
 oculatum?
Lithocyelia ocellus.
 stella.
Stylocyelia dimidiata.
Astromma aristotelis.
 pythagoræ.
Flustrella concentrica.
Stylodictya hastata.
 clavata.
 forbesii?
 ocellata.
 splendens.
Hymeniasstrum pythagoræ.
Histiastrium quaternarium.
Periphæna decora.
Stephanolithis spinescens
 annularis?
Cornutella cucullaris.
 quadratella.
 ampliata.
 mitra.
 clathrata.
Dictyophimus craticula.
Lithomelissa capito.
 macroptera.
Lychnocanium tripodium.
 hirundo.
 tricopus.
 ventricosum.
 falciferum.
 lucerna.
 tribulus.
 tridentatum.
Lithopera lagena.
 amblyostauros.
Anthocytis mespilus.
 collaris.
 hispida.
 ficus.
 ventricosa.
Carpocanium coronatum.
Cryptoprora ornata.
Lophophæna galeata.
 apiculata.
 radians.
Peterocanium barbadense.
 contiguum.
Peterocodon apis.
 campana.
 campanella?
Podocytis rhizodon.
 mitrella.
 argulus.
 argus.
 attenuata.
 parvipes.
 triacantha.
 papalis.
Podocytis princeps.
 puella sinensis.
 tetracantha.
 ventricosa.
Thyrsocytis dionysia.
 rhizodon.
 jacchia.
 lyæa.
Lithocorythium oxylophos.
Lithornithium loxia.
 luscinia.
 foveolatum.
Rhopalocanium ornatum.
Lithochytris pileata.
Cycladophora spatiosa.
 discoides.
Calocyclus turris.
Eucyrtidium asperum.
 gemmatum.
 apiculatum.
 mongolfieri.
 ampulla.
 biauritum.
 embolum.
 sphærophilum.
 sipho.
 montiparum.
 elegans.
 imbricatum.
 attenuatum.
 versipellis.
 microporum.
 pirum.
 cylindricum.
 articulatum.
 pauperum.
 stephanophorum.
 ficus.
 excellens.
 tubulus.
 scolopax.
 eruca.
 pusillum.
 cancerinum.
Lithocampe ampullacea.
Dictyospyris spinulosa.
 clathrata.
Petalospyris foveolata.
 flabellum.
 confluens.
 eupetala.
 ocellata.
Ceratospyris didiceros.
 heptaceros.
 longibarba.
 fibula.
 stylophora.
 dirrhiza.
Cladospyris bibrachiata.
 tribrachiata.

Lithobotrys stiligera,
adpersa,
gemmata.

Lithobotrys nidus pendulus,
cribrosa?

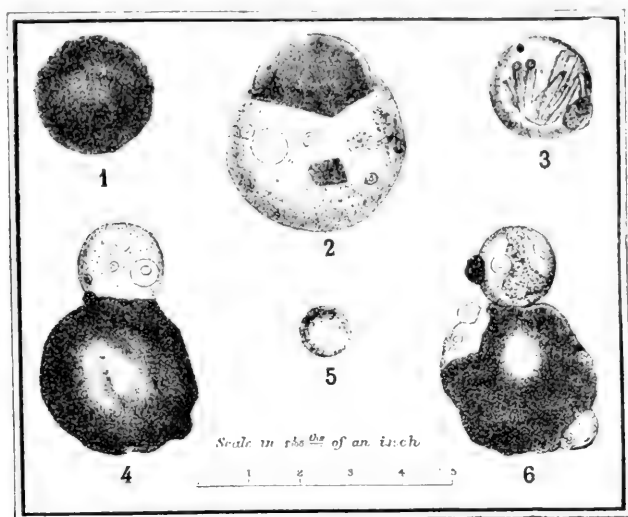
Now, just count up the number of genera and species in this list and see the significance of it. Of the 282 species figured by Ehrenberg as found in this deposit, here are 136, or nearly one-half; of the 43 genera, here are 39, or all but four. How is that for one summer's work? Need I say that I was thoroughly satisfied with it? I will not undertake to say that all of those species are named correctly. It will be noticed that in about a half a dozen instances I have put a question-mark after them. And possibly there are others that are doubtful or wrong. But the point is this, that, unless I am very much mistaken, they are either right or they are not given by Ehrenberg—in other words, belong to the 141 species figured by Mrs. Bury, or to the 80 species which Haeckel estimates that this deposit contains over and above the 423 figured by them both. And in addition to these that I have named there are on these slides of picked forms, besides duplicates, about 100 species that I have not as yet been able to place at all. In some cases I could not even be sure of the genus. As to the genera given in the above list, however, I am confident that, with scarcely an exception, they are correct. What better material, therefore, could a man ask for than this same Barbadoes earth? But these 136 species did not all come from one locality. They represent no less than five. Springfield and Malvern Hill, however, furnished 32 out of the 39 genera, so that the material from those two localities will be all that the student requires to enable him to study the genera very satisfactorily. And when he has found all those 32, if he will take the trouble to drop me a line, I will send him some material that will supply two or three genera more.

On Some Minute Magnetic and Hyaline Spherules Found in Terrace Dust.

[From Bulletin of the Microscopical Society of Calcutta.]

In the accompanying figures will be found illustrations of some very minute particles of a glassy nature which were first collected by Mr. C. Blechynden, of Calcutta, by means of a magnet, in the dust gathered upon the flat-roofed houses of that city, some of them at a considerable height. He suggested that they might be of meteoric origin. Mr. W. J. Simmons made drawings and prepared the following descriptions. He was inclined to agree to the theory of meteoric origin on account of the rounded, smooth surfaces, glassy appearance, and magnetic characters—properties that would characterize molten cosmic material falling through the atmosphere. He said:

"The coarse-grained, dark-colored dust which drifts, as all Calcutta residents are aware, into the leeward corners of our flat house-tops is found to contain, mixed with dried portions of organic matter, certain magnetic and hyaline granules which present appearances highly indicative of previous fusion. These appear mostly as opaque or translucent spheroidal bodies, sometimes single and isolated, and sometimes composed of more than one spherule fused together, varying in size from $\frac{1}{1000}$ th to $\frac{1}{250}$ th of an inch in diameter. The opaque bodies vary in color from black to rusty red, whilst the transparent spheres, by transmitted light, are light-brown or yellowish, like colored glass. They



EXPLANATION OF FIGURES.

- | | |
|---|--|
| 1. Opaque, shot-like granule. | 5. Small hyaline spherule. |
| 2. Spherule including a dark crystalline mass, bubbles, and a protruding opaque mass. | 6. A composite opaque and hyaline grain with bubbles and crystals. |
| 3. Hyaline spherule containing crystals. | |
| 4. Dark mass with a hyaline body including bubbles. | |

frequently include bubbles, patches of granular matter, and, more rarely, crystals. The surfaces are usually smooth, and occasionally bubble-like protuberances bulge out the sides. Composite grains are not uncommon in which a glassy mass protrudes from an opaque body. Particles presenting these characters have been obtained from house-tops widely separated from one another and at considerable heights, as on the tower of the High Court—facts which are of importance in considering any conclusions as to the origin of this material."

One member was of opinion that they might have originated as sparks from horseshoes in the streets, from the tram-lines,

railways, or even from factory-chimneys, but it was found that in the street-dust magnetic as well as other particles which had been formed by horseshoe denudation were almost always jagged in outline and showed none of the characteristics of the spheroidal bodies in terrace-dust. All know the great distances to which volcanic ejectamenta were carried after the great eruption of Krakatoa.

Mr. J. Wood-Mason said he had found similar bodies and thought that they might be the residue from the disintegration of the building materials used in construction of the roof and parapets.

Mr. Holland remarked that the rounded, smooth surfaces of the opaque as well as the translucent bodies were decidedly suggestive of previous fusion, and having discussed the possibility of their being carried from the roads during the dust-storms of May, he thought the evidence, taken as a whole, limited the conclusions either to the author's view of their cosmic origin or, according to the president's suggestion, to the Public Works Department. He had examined the material in the chemical laboratory, but the evidence so obtained did not exclusively favor either view. After removal of the organic material, the residue consisted of quartz-granules with a few splinters of augite and biotite insoluble in hydrochloric acid, and a soluble portion, composed principally of iron oxide with lime, soda, and potash. One specimen contained small, though distinct, particles of metallic iron, but not a trace of nickel could be found. Quartz has not with certainty been found in meteorites, although silica in the form of asmanite was found by Professor Maskelyne in 1867. The quartz in Mr. Simmons' specimens was in angular fragments and would not, of course, be removed with the ferruginous particles by the magnet. The presence of this mineral, though not necessarily connected with the magnetic spherules, and absence of nickel in the spherules themselves, though worthy of consideration, must only bear the weight of negative evidence. But there remained the magnetite, the glassy globes, and the metallic iron, hinting quite as strongly in favor of their meteoric origin. In reviewing some of the popular notions concerning meteorites, he pointed out that recent researches, especially those of Lockyer, have taught us to regard these bodies as neither so strange nor so uncommon as was formerly imagined; and, notwithstanding the inconclusive state of the evidence in the present instance, he would favor the meteoric origin of these particles.

Mr. P. N. Bose said the streets were paved with basaltic rocks from which the magnetite, as well as the augite mentioned by Mr. Holland, could have been derived. Rounded particles could be more easily carried by the wind.

Microscopical Technique Applied to Histology.—II.

[From the French of M. René Boneval.]

(Continued from page 40.)

Imbedding in Paraffin.—Procure a soft paraffin that melts at 45° C., a harder kind fusible at 55° C., and some fusible at 69° . They all should be homogeneous. With these three kinds, by combinations in different proportions, we may obtain masses fusible at a given temperature.

The specimen taken from 90° alcohol is placed in absolute alcohol for 24 hours. When completely dehydrated pour into a test-tube 2 c. c. of absolute alcohol, and fill a small pipette with cedar oil. Introduce the point to the bottom of the test-tube, and let the oil run out slowly. Two layers are thus formed—the upper of alcohol, the lower of cedar oil. Gently introduce the specimen, which remains suspended between the two layers. Penetration is effected very slowly; some hours after the liquids mingle by diffusion, the specimen falls to the bottom. Transfer it then to cedar oil.

It is now necessary gradually to replace the oil by paraffin. . . . Fill an iron vessel with water, on which float a plate of cork pierced with holes of different sizes. A spirit-lamp will give a constant temperature, aided by a thermometer in the water. Into each hole in the cork place one of those lead capsules used to cap certain kinds of liquor bottles, turning up the edge to prevent it from falling through. In these capsules we imbed the object, to which we now return. After 24 hours in the cedar oil add to the liquid small fragments of paraffin and heat to about 35° C. The object should remain here for a variable time; *general rule* 5 or 6 hours for an object 2 mm. in diameter. Transfer to the hard paraffin heated to 55° , in one of the lead capsules. Leave it here for 5 or 6 hours if it is small; for 24 hours or even longer if the size is large. While the paraffin is still soft we arrange the object in it; lift out the lead capsule and cool it by floating the cork on cold water. Tear off the lead when the paraffin is solid, and from the mass cut out a cube containing the object.

Imbedding in paraffin demands long and laborious manipulations, and alters very delicate structures. It should be used only when large and uniform sections are desired. It is very serviceable when used in conjunction with celloidin imbedding. The latter has the advantage of maintaining the organs in place, but does not form hard masses. We obtain the advantages of both methods by combining them. The piece infiltrated with celloidin and hardened in *chloroform* is placed for 24 hours in a mixture of chloroform and paraffin heated to 35° C. Transfer to hard paraffin heated to 55° , and proceed as for imbedding in pure paraffin.

SECTION-CUTTING.

The tissues being fixed, hardened, and imbedded, it is necessary to cut them into thin sections with a certain area. There are many processes and instruments by which to attain this. . . . We advise the use of Weiss's English razor. . . . When a good razor has been obtained most carefully, keep it away from a manufacturer or a cutler. We make this remark whenever we see a razor put into their hands, for on its return it will be exceedingly brilliant, *but it will not cut*. This is singular, but easily proved by experience. It is as important that the histologist should know how to sharpen a razor as to know how to use the microscope. Buy a razor strop and a good stone with a fine grain. Pass the razor back and forth over the stone moistened with neat's-foot oil, applying the blade lightly upon the stone, and always holding the edge forward (*toujours le tranchant en avant*). When well sharpened pass it several times over the leather and wash in alcohol to remove the oil. . . .

Free-Hand Cutting.—This demands a certain manual skill, but it is of great instrumental simplicity, as it requires only one instrument, the razor. . . . Take a stick of elder pith as large as possible and remove the outer layers, which are filled with silica. Cut a furrow in it longitudinally. Gently separate the edges of the cleft, and between them place the tissue imbedded in gum. The elasticity of the pith will hold the object in the cleft. Take the pith between the thumb and finger of the left hand, and the razor in the right hand. Dip the blade in alcohol and while wet boldly cut through the object. . . . It is well to support the razor on the thumb nail. The following method by Ranvier for the study of nerves will make the operation easier: The piece, well sponged off with bibulous paper, is placed in a little hollow made in the pith. Then pour into the cavity a mixture of pure wax and oil, raised to a temperature not to exceed the melting point. "When the mixture is cold, the first cut having leveled the surface of the three bodies (pith, wax and oil mixture, object) to make the second, with the razor depress the surface of the pith so as to elevate as small a quantity as possible of the wax and of the object; cut by a single stroke made more certain as the razor rests on a guiding surface. The pith thus used takes the place of a microtome." Whatever plan may be adopted the sections float in the alcohol on the blade, and may be removed by dipping the razor in water.

Cutting with the Hand (or Ranvier) Microtome.—A long apprenticeship is needed to cut good sections by the foregoing method, and there are a great number of microtomes intended to make the procedure entirely mechanical. Ranvier's is the simplest of these. "It is formed of a hollow cylinder, having at one end a flat plate and at the other a micrometric screw, which raises a piston within the cylinder." To make thin sections by this microtome, take rods of elder pith freed from the silicious layer, and

flatten them by compressing them in the fingers. Lower the piston of the microtome until there is room enough to receive the specimen, which is solidly wedged in by the compressed pith, and invert the microtome in a vessel of alcohol. The swelling of the pith fastens it more firmly in place.

The preparation, arranged in the microtome, is raised by the screw till level with the platform, then more or less above. After leveling the surface by cutting off the projecting irregularities, if the screw is moved a fifth, a fourth, a third of a turn, we can with a razor, one face exactly applied to the platform, cut very thin sections. As in free-hand sectioning, it is necessary that the razor and the tissue be covered with alcohol. This is easily done by dipping the microtome and the razor after each cut into a saucer of alcohol. Ranvier's microtome is a valuable instrument to the histologist, and should be procured when he buys his microscope. It is specially useful for section-cutting with gum imbedding, but to obtain good results the tissue should be saturated and well hardened. . . .

STAINING.

Sections . . . should be prepared for staining by methods differing according to the imbedding material.

1. When simply hardened by alcohol, picric acid, the bichromates, or imbedded in gum, the sections are placed at once into a basin of water. They are left there for a certain time, when they are ready for staining. When fixed by picric acid, the yellow color must be removed; when infiltrated by gum, coloring agents should be used only after its entire removal.

2. Sections cut in celloidin should be placed in alcohol, then on the slide and treated differently, according as to whether they are to be stained by an alcoholic or an aqueous solution. In the former they are treated by a series of alcohols more and more diluted (alcohol 820, and at $\frac{1}{3}$), finally by water and by the stain. In the second case the section is stained immediately after leaving the alcohol. Sections in celloidin should be stained without removing the imbedding material. With paraffin sections all the paraffin should be first removed. The section is spread on the slide by a dry brush, and benzine added till all traces of the paraffin have disappeared; let the excess of benzine run off and substitute absolute alcohol. We then proceed as for celloidin sections The histological student should by all means procure the following stains from among the great number used: ammoniated picro-carmin, alum carmin, hæmatoxylin and a few aniline colors.

To stain sections with picro-carmin.—This may be used after any fixing reagent; but it is after alcohol and imbedding in gum that the best results are obtained. By needles place the section on the slide; sponge off the excess of water by bibulous paper; let fall a drop of the picro-carmin on the section. Examine with a low power, and when the stain is deep enough add

the thin cover. We then replace the picro-carminé by a preservative liquid, with precautions to be referred to hereafter. Tissues fixed by osmic acid or by the bichromates are stained by picro-carminé with great difficulty . . . Such sections are placed for 24 hours in a corked tube filled with a mixture of equal parts of picro-carminé and water. They are then washed, and mounted as described for sections treated with alcohol. This does not give the fine results obtained by the preceding method. The washings needed to remove the picric acid destroy those shades of color obtained by the action of picro-carminé . . .

Alum carmine.— . . . Ammonia alum, 1 to 5 grms.; carmine, 4 grms.; distilled water, 100 grms. Boil for 20 minutes, taking care to maintain the original volume by adding water. Filter and preserve by a crystal of thymol. It is a nuclear stain of the first order; it colors admirably the nuclei of tissues fixed by osmic acid, which makes it valuable in many cases where picro-carminé is worthless. And, further, the color is well preserved in glycerin. Place the sections for a few hours in a vessel containing one c. c. of alum carmine, and wash until the excess of color has been removed.

This stain is exceedingly penetrating, so that tissues may be colored "in mass." After washing, which follows the action of the fixative, place the specimen in a test-tube containing 2 or 3 c. c. of alum carmine. After a variable time (one or two days) transfer to water, which should be renewed as long as it is tinged with carmine. The tissue is then passed through alcohol and imbedding materials. . . .

Hæmatoxylin.— . . . With a little attention it is here possible to get good coloring after all fixing reagents, but to obtain perfect nuclear selection the hæmatoxylin should be applied to pieces fixed by the bichromates. The best way to use it is to put the sections in a vessel with a few drops of the stain. If the tissue has not been long in the bichromate, it will stain in from 15 to 20 minutes; with other reagents, one or two hours are needed. When stained, wash in water and mount in balsam; glycerin destroys the color. Beautiful preparations may be had by combining hæmatoxylin and eosine.

Aniline colors.— . . . Of these, procure methyl green, eosine, quinolein blue, safranin, gentian violet, and methyl blue. The best way to use them is to make saturated solutions in absolute alcohol, and keep in well-stoppered bottles. They should be filtered when needed, and diluted with an equal volume of distilled water. . . . Eosine is habitually used as a complement to Ranvier's hæmatoxylin, by placing the section stained by hæmatoxylin on the slide, washing it well, and coloring with eosine in alcohol or in water. . . .

Impregnations.—This name is given to the coloring produced by the formation within the elements of metallic deposits in a state of very fine subdivision. Nitrate of silver and chloride of gold are always used for this purpose.

Nitrate of silver.—A solution is made in distilled water of 1 gm. of silver nitrate to 100 of water, and kept in a black glass bottle. For use, one part of this is mixed with 3 parts of distilled water.

1. A membrane, the omentum for instance, has the solution poured over it. When the tissue begins to get opalescent place it in the sun, in a vessel of water. Mount in glycerin. . . . Do not touch the membrane with the fingers, and if it is soiled with blood wash it very rapidly in distilled water.

2. Extend the membrane on the slide, let it dry till it adheres to the edges of the glass, and pour on it the silver solution. Expose to the sun, and wash in distilled water. . . .

Nitrate of silver has the power to make out the contour of the endothelial cells, by being reduced upon the intercellular cement. In certain cases it is good to color cell nuclei. Wash, stain for half an hour in alum carmine, wash again, and mount in glycerin or in balsam.

Chloride of gold.—This is almost exclusively used for the study of nerve endings. A one per cent. solution is kept in a yellow bottle. . . .

SUMMARY.

Fixation by alcohol.—A fragment of tissue the size of a small hazel-nut is placed in 50 grammes of 90° alcohol for 24 hours.

Hardening.—Place the tissue in water for 20 minutes. Transfer to a solution of gum arabic for from 24 to 48 hours. Absorb the mucilage from the surface by bibulous paper and place in 60 grms. of 90° alcohol for 48 hours.

Sections.—Free-hand, or by Ranvier's or some other microtome. Put the sections in water for 20 minutes.

Staining.—Place the sections on a slide, stain with picro-carmine, and mount, some in acidulated glycerin, others in glycerin with a little picro-carmine

Fixation by osmic acid.—A piece of tissue 1 mm. or more in diameter is placed in 1 or 2 c. c. of osmic acid for from 12 to 24 hours. Wash in water for 12 hours.

Hardening.—When taken from the water make free-hand sections, or, if too soft, imbed in gum.

Sections.—Free-hand or by microtome. The sections remain in water for only a few minutes.

Staining.—Transfer to a vessel full of alum carmine, 1 hour. Wash in water for 5 minutes.

Preservation.—Mount in water, which is to be replaced by allowing glycerin to run under the cover. . . .

Fixation by bichromate of ammonia.—A fragment of tissue centimetre or $1\frac{1}{2}$ centimetres in diameter is placed in 100 grms. of bichromate of ammonia. Leave it there for 10 days, often renewing the solution. Wash for 24 hours in a large quantity of water to which is added a crystal of thymol or of carbonic acid.

Hardening.—Imbed in gum as described.

Sections.—By microtome; sections to remain in water 20 minutes.

Staining.—By haematoxylin and eosine.

Preservation.—In dammar.

[M. Boneval does not like Canada balsam as a mounting medium, preferring dammar. Hereafter, whenever the word "balsam" is used it will be understood that the author means dammar, although either balsam or dammar may be employed, as the reader may prefer.]

[To be continued.]

The Contractile Vesicle of *Paramecium*.

By ALBERT SCHNEIDER, M. D.,

MINNEAPOLIS, MINN.

The functions of the contractile vesicle in protozoons are but little understood, in spite of the fact that careful work has been done on them. Doubtless the question will not be fully solved for some time. The cause of the difficulty is probably to be found in the delicate chemical reactions involved. The assertions of earlier zoölogists were misleading. Some described the contractile vesicle as a sort of "water pump," others as a "heart." Stein mentions the "nearly pure water" found in the contractile vesicles, and how "it is forced to the exterior through an opening or openings in the cell-wall." The comparison to a "heart" is far fetched and meaningless. Bütschli (1881 and '82) seems to incline towards Stein's view. One gains but little satisfaction from the present literature on the subject. Though I am not now able to make any conclusive statements, yet I hope to contribute something towards solving the mystery. I have made a special study of it.

I used a $\frac{1}{2}$ -in. Zeiss objective with B. ocular. In order to reduce the activity of the organism, I used CO_2 and chloroform vapor. This was rather unsatisfactory, owing to the care required in admitting the reagent. The slightest excess would soon destroy life. Besides, the conditions were far from normal. A far better method is that suggested by Professor H. F. Nachtrieb, of using a solution of cherry gum just thick enough to render the specimens comparatively inactive. By this method I could keep them alive for hours and study both their movements and the action of the contractile vesicle. The mechanical parts of the experiments I need not describe, as they were very simple.

As is well known, *Paramecium aurelia* has two contractile vesicles located in the ectosarc opposite the ventral side. As a rule, they contract alternately with great regularity. The average time required for a complete pulsation is about one

minute. Anything that reduces the vitality of the organism will reduce the number of pulsations in a given time. Whether there is any connection between the two vesicles I am unable to state. There was no visible connection. Death takes place, as a rule, during a diastole; the vesicle often increasing to such size as to rupture the cell-wall. I made the most careful observations to find Stein's openings in the cell-wall for the ejection of "water," but could not find any, neither one nor several. I found indications of a "tube." It was temporary, however, forming a part of the vesicle and extending only to the cell-wall. More often this projection was absent. In looking vertically downward upon the ciliated cell-wall the points of attachment of the cilia gave the appearance of black dots. These might be mistaken for openings, especially when just over the contractile vesicle and after its contraction because of the sinking of the cell-wall. I am certain that no currents due to any ejection of liquids are noticeable.

I shall now give a more complete description of the contractile vesicle. It is a temporary cavity formed in the ectosarc, with canals leading to it. These canals are much enlarged where they join the main vesicle. These expansions, which are generally spherical, I will call secondary vesicles or *Vorhöfe*. The canals (conducting canals) are long and slender and always located in the ectosarc, and have no apparent connection with each other. Their number for each vesicle varies from four to seven or eight. Sometimes neither the canals nor *Vorhöfe* are visible. The vesicle, *Vorhöfe* and canals are not lined by a membrane. Their position is not absolutely fixed. Whether the slight shifting is due to a change in position of the vesicle or to the entire protoplasmic mass I am unable to state. I have divided a complete pulsation of a vesicle into three periods: 1, the systole of the vesicle; 2, the rest period of the vesicle; 3, the diastole of the vesicle.

To speak of the movements of the vesicle is misleading, because there is no such organ or structure as a contracting vesicle. It would be more correct to speak of the movements or contractions of the cell protoplasm, causing the appearance and disappearance of the vesicle. But for convenience sake we shall continue to speak of the vesicle as an organ. The following will assist in giving an idea of a complete pulsation of the vesicle:

I. SYSTOLE OF VESICLE: AVERAGE TIME, $\frac{1}{2}$ SECOND.

MOVEMENTS.—Vesicle contracts suddenly.

Vorhöfe expands.

Canals expand slightly.

POSITION.—Vesicle contracts eccentrically towards exterior.

Vorhöfe remains in position.

Canals remain in position.

II. REST PERIOD OF VESICLE: AVERAGE TIME, $\frac{1}{2}$ SECOND.

MOVEMENTS. — Vorhöfe begins to contract.

POSITION. — Vorhöfe in same position.
Canals in same position.

III. DIASTOLE OF VESICLE: AVERAGE TIME, 59 SECONDS.

MOVEMENTS. — Vesicle expands suddenly at first, then slowly.

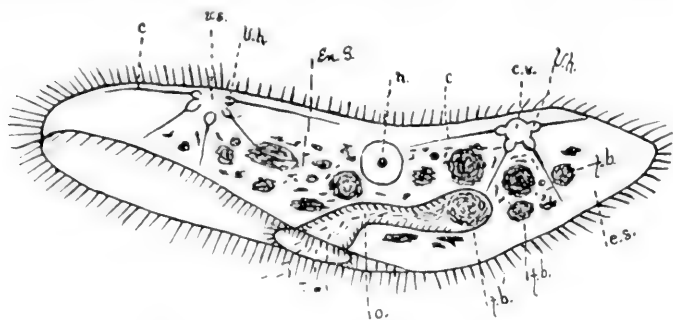
Vorhöfe contracts at first and then slowly expands.

POSITION. — Vesicle expands from a central point.

Vorhöfe in same position.

Canals in same position.

Enough has been said concerning the general structure of the contractile vesicle; let us now turn our attention to its probable function. In the first place, it should be determined whether the content of the vesicle is a gas or a liquid. I am quite fully



EXPLANATION OF THE FIGURE.

Paramecium aurelia.

c. v., contractile vesicle in diastole. v. s., vesicular systole.
Vh., Vorhöfe. c., canals. n., nucleus. o., oesophagus. es.,
ectosarc. en. s., endosarc. f. b., food vacuoles. f. b., food
bolus in process of formation.

convinced that it is a gas, because microscopically it gives the appearance of a gas bubble suspended in a liquid or a semi-liquid. I have tried various stains and in no case was the contents of the vesicle stained, either before or after the death of the *Paramecium*. If there were a liquid it would certainly be stained after the death of the animal if not during life. I have also often noticed that when the organism slowly died the vesicle enlarged to such an extent as to rupture the cell-wall and allow the contents of the vesicle to protrude as a gas bubble which was finally absorbed by the water. The composition of this gas is not known. It is probably a gas formed by metabolic processes going on in the living organism.

The attempt to establish the presence of uric acid crystals in the vesicle gave very unsatisfactory results. I am not inclined to the belief that the function of the vesicle is essentially excretory. I believe the prime function is respiratory and circulatory. It is to facilitate the interchange of CO_2 in the interior and O in the surrounding water. During a diastole an interchange of gases takes place by osmosis. By means of the canals and Vorhöfe, CO_2 , or at least a gas highly surcharged with CO_2 , is conducted to the vesicle, where some of the CO_2 is exchanged for O taken from the water. A deficiency of O in the protoplasm, probably acting as a stimulus, causes a contraction and forces the gas, now containing an excess of O, through the Vorhöfe and canals into the general system. The vesicles are always located in such a position as to favor the supply of oxygenated water. In a free swimming organism, like the *Paramecium*, it does not matter so much where they are located, as their continuous motion brings them in contact with oxygenated water. In fixed organisms, like *Vorticella*, the vesicle is located near the oesophagus, where there is a continuous current of water kept up by the cilia.

When a circulatory and respiratory function is mentioned it must not be understood as at all similar to respiration and circulation in man. Let there be no misunderstanding on that score.

SUMMARY.

1. The two contractile vesicles of *Paramecium aurelia* contract alternately with great regularity.
2. The essential parts of a contractile vesicle are the vesicle, Vorhöfe, and canals.
3. There are no visible openings connecting the vesicle with the exterior.
4. There is no visible ejection of any substance from the vesicle.
5. The function of the contractile vesicle is probably respiratory and circulatory.

The contractile vesicle probably has no excretory function.

The Spiracles of the Click-beetle.

By EDWARD GRAY, M. D.

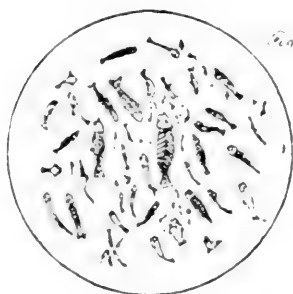
SANTA CRUZ, CAL.

In a previous article upon this subject, which was published in this periodical for November, 1891, the writer put the question, who could aid him in obtaining specimens of the cylindrical grub of the click-beetle, sometimes called the wire-worm. During the year 1892 no response was received, but within the past fortnight a well-prepared slide of this object has reached the writer from Mr. F. Dienelt. This slide is superior to that which called forth the article named, and establishes the

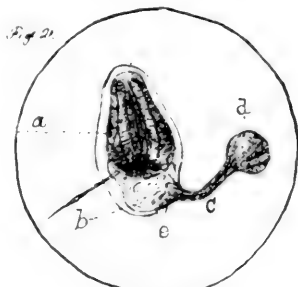
fact that the creature in question is the larva of one of the Elateridæ, or "spring-beetles." These spiracles are of remarkable shape and development. The manner in which the elliptical opening is subdivided into two symmetrical divisions, and these overarched by plates like translucent whalebone, is best set forth in a drawing, being difficult of any adequate verbal description. Lining the inner walls of the spiracle may be seen numerous hairs. The office of these is obvious. But it is the office of the remaining constituent parts which need explanation—the ovoid sac and the tube with its funnel like expansion. The recent preparation shows very clearly that the largest tracheæ begin at one border of the ovoid sac and extend a measurable distance before subdividing. The spiral thread which holds open the largest tracheæ is particularly well developed and heavy. The function of the sac and the trumpet-shaped tube have no further light shed upon them.

Of what character the spiracles and tracheæ of the adult beetle are, whether of the same type as those of the larva or otherwise, is not at present known to the writer, no material of this character being thus far available.

In the figure below which shows the spiracle and accessories of the larva of click-beetle $\times 80$. a = spiracle, b = sac, c = tube, d = funnel expansion, and e = otoliths.



A human tear (?)



Spiracles (Gray).

EDITORIAL.

Newspaper Trash.—Some time since, one of the New York city newspapers, which claims a large circulation, published an article upon the dramatic uses of weeping. It filled a column with the cheapest of trash, amongst which was a picture labelled: "A human tear under the microscope," and the following paragraph:

"A tear seen under the microscope presents some interesting deep-sea views. When magnified, say, 10,000 diameters, minute

fish-bones are plainly visible. This at once opens a very interesting field for investigation; and it will be for future microscopists to determine the various species of fish shed under varying circumstances—whether they be trout, rock bass, or embryonic sturgeon, although the probability is that tear-fish are in most instances allied closely to the family of bluefish. However that may be, a tear is composed, as science tells, of water, minute proportions of salt, soda, phosphate of lime, phosphate of soda and mucus, and when seen under the microscope after evaporation a deposit of minute fish-bones are formed by the salines, these arranging themselves in lengthened cross-lines, as shown in the picture of the human tear under a powerful glass."

The cut is reproduced exactly on page 84. We have shown this article and cut to several intelligent people, who supposed the statements might be true. It is fair to assume that of the average newspaper readers, one-half are too ignorant of the subject to successfully question the statements.

What pleasure an editor can take in thus deceiving the ignorant classes we are at a loss to know. It is not possible for us to correct the evil he has accomplished, but we can and do denounce such journalism as utterly and inexcusably bad.

Scientific Names.—Soon after writing the February editorial a good illustration of what was there said about the absurd practices came to our notice in *Erythæa*, the new botanical magazine.

It seems that Linnæus gave the name *Myosurus minimus* to a little annual commonly called Mouse-tail. That is, he called it "the smallest" mouse-tail—*minimus*. But, as a matter of fact, it is the *largest* of seven species belonging to this genus. The *Nabalus altissimus* grows from 3 to 6 feet in height. Its name says it is "*the tallest*," but *Nabalus crepidineus* grows to eight feet in height. The specific names *alba* and *nigra*, as well as others denoting color, are sometimes misapplied. A prominent naturalist recently said to us that he can recommend absolutely no reliance being placed upon such words—they may or may not correspond with some important character of the object. Science is said to be exact knowledge, and yet every beginner must learn not to be misled by such names or he will get into serious confusion. And yet what is being done to remedy such unscientific science? Can we be permitted to correct such blundering? Let the leading botanist of the Pacific coast answer:

"In dealing with the second species of *Myosurus* that was made known, our monographer uses a kind of freedom which is not in our day commonly allowed. Between two names, *M. apetalus*, which has priority, and *M. aristatus*, which is more appropriate, he chooses the latter. * * * It is perhaps true that there is less injustice in rejecting a prior name that is bad than one that is good; because, it may be said with reason, that no man has a right to impose on a species an unfit name. But the consequences

to the stability of nomenclature are alike in the two cases. If names are not to stand, whether apt or inapt, according to strict priority, changes will be perpetual."

So, no matter what changes advancing knowledge or changed conditions may suggest, the only thing that these people can advise is to observe strictly priority. If science has told a lie, stick to it. We beg to say that such scientists put themselves exactly on the par with the colored gamin whom we saw selling doughnuts on Pennsylvania avenue Inauguration day. He kept crying, "Hot doughnuts, year's your 'ot doughnuts." A customer, having nearly broken a tooth in biting the frozen pastry, called out: "Here, boy, these doughnuts are not hot." "I knows it, boss," replied the urchin; "that's just the name of 'em." So, like this ragged negro boy, the professors say that the Mouse-tail is *minimus*, and when a student remarks that the one in hand is *not* the smallest, the professor can only respond, "I knows it, boss; that's just the name of 'em." Then the professor looks over his spectacles, utters some trash about the sacredness of priority, and wants the student to respect him more than we respect the lying street peddler.

Titles of Microscopical Publications.—A good many favorable responses have been received to our question in the February number as to the desirability of such a list, and some very valuable suggestions have been made. To satisfy those who think that they would prefer a larger type, we now reprint the list of February with a different type and with spaces between the items. If the latter proves preferable to our readers in general, we will continue in this style. The "Letters to the Editor" on this subject have been crowded over from the March to the April number.

LETTERS TO THE EDITOR.

NOTE.—This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.

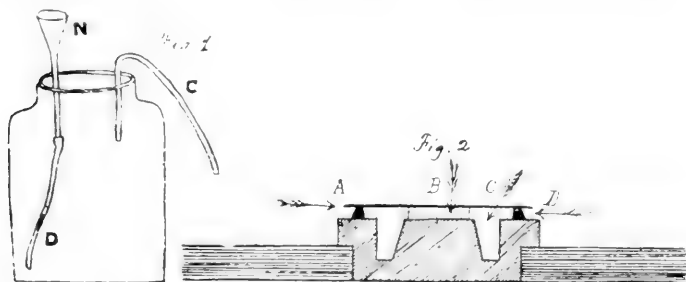
(7) **Terrace Dust.**—Referring to the article on hyaline bodies found in terrace dust (published in this number), some further investigation is desirable. If any of the microscopists in the United States would "magnetically sift" some dust from *house-tops* and then brushing off the few particles which adhere to the magnet poles (using preferably a horseshoe magnet), would mount them in balsam and examine them with the microscope, it could be determined whether or not the same bodies occur in that part of the world.

W. J. SIMMONS.

CALCUTTA, Jan. 15, 1893.

MICROSCOPICAL APPARATUS.

Washing-Bottle For Microscopical Sections.—The accompanying sketch of Maw's apparatus for washing sections shows an arrangement that has been found to be an improvement upon that described by Marsh in his book on Section Cutting. Instead of drilling a hole in the side of the bottle for overflow, a siphon through the cork is used. This draws the water off at or near the centre and does away almost entirely with the chance for thin sections being caught against the hole in the side—an objection to Marsh's apparatus. A is the bottle, N the funnel, C the siphon, and D the india-rubber tubing connecting the funnel with the side of the bottom of the bottle.



A Convenient Life-Slide.—The slide illustrated above is placed on a turn-table and a cell of melted bee's-wax made. The object is placed in the centre and a thin glass cover put on and pressed down hard with a piece of thick plate-glass, otherwise the slide can be inverted and pressed on any hard flat surface till the cell is in contact with the cover all around.

One often finds very interesting objects, and with this slide can mount them so they will be ready for re-examination if called away. They will remain alive and in good condition from one day to a week.—*Meyer Bros.' Druggist, Nov., 1892.*

MICROSCOPICAL MANIPULATION.

Two Methods of Detecting Tubercle Bacilli in Milk.—In examining milk which is suspected to contain the tubercle bacillus, it is usual to subject a sample of the milk to the action of a centrifugal machine after separating the fat. The casein in 20 c. c. of milk is coagulated with citric acid, and, after filtering, the residue is dissolved in a solution of sodium phosphate. The butter-fat is separated by shaking with 6 c. c. of an aqueous ether solution,

and acetic acid is then added until the liquid is on the point of coagulating. It is then placed in a copper tube tapering at the bottom, and this tube is inserted in the centrifugal machine and turned at the rate of 3,000 revolutions per minute for 15 minutes. The bacilli collect at the narrow end of the tube, together with other sediment and dirt. The liquid is poured off, and the sediment examined microscopically.

Another, Thörner's method, is this: 20 c. c. of suspected milk are mixed with 1 c. c. of 50 per cent. potash solution and heated in a bath of boiling water until the fat is saponified, when the solution turns yellowish brown. By this treatment the casein and albumen become soluble in acid. Add 20 cubic c. c. of acetic acid, shake the solution, heat on water-bath for 3 minutes, transfer to a strong glass tube and turn in the centrifugal machine for 10 minutes. The liquid is then poured off and the sediment is washed by shaking with 30 c. c. hot water, and again turned in the centrifugal machine. The water is poured off and the sediment placed upon cover-glasses, which are treated in the ordinary way, staining with hot Neelson solution, decolorizing in 25% sulphuric acid, and finally staining in methylene-blue. Instead of washing the cover-glasses in sulphuric acid, Thörner simply uses a solution of methylene-blue containing sulphuric acid.—*Nature*, Jan. 12, 1893.

To Mount Fish-Scales.—In preparing fish-scales as transparent slides for examination by polarized light, or with a black background, they are usually mounted in Canada balsam to render them transparent, but this means of mounting gives a dull and muddy image; their appearance is greatly improved by mounting them in a mixture, half alcohol and half water, the image is brighter and clearer, and the colors with polarized light and a selenite plate much more brilliant.

By using a Herapathite film mounted as the analyzer the image is very much brighter, and the colors stronger when using the selenite than with a Nicol eyepiece; but without the selenite plate the field gives only a dull brown color, instead of being a deep black, as with two Nicols.

It is very desirable that the scales should be perfectly clean and free from the slime that adheres so obstinately, especially in such scales as have strong spines, as the sole, perch, etc. The scales, when possible, should be gently detached from the fresh skin, being careful not to break off any of the spines, and cleaned by steeping them in warm water and gently brushing off the mucus with a camel's-hair brush; but if this does not succeed in perfectly cleaning them they should be digested for some hours with pepsin, when they can be thoroughly cleaned. As it is difficult to find a means of fixing the scales to the slide when mounting in spirit, the cells should be made in the turn-table with asphalt to such a depth that the cover-glass when mounted will hold them with a slight pressure.—*No Sig. Paris*.

DIATOMS.

Möller's Diatom Plates.—In the introduction to this volume are the following items of interest:

The correct determination of diatoms is only possible when based upon good illustrations, and these should receive the utmost care. One draughtsman treats his drawings diagrammatically, another ornamentally, and still another depicts only outlines, or thin sections, as if it were easy to gain a conception of the whole therefrom. Some authors deem a rude, primitive drawing sufficient when accompanied by a good description. Instead of giving a representation of an ideal section of a simple discoid form, a long, confusing explanation is furnished. While a short description will be of value, a good illustration without any description is useful, while the best description alone is insufficient. The variation in drawings and illustrations of comparatively well-known species is so great that, were they placed singly in the form of a type plate, the resulting confusion would be simply appalling. In the interest of a more reliable literature of the diatomaceæ, we need a careful reproduction of those acknowledged faithful drawings of all specific forms. This would be of incalculable value to students of these most minute and beautiful plant forms. If drawn to uniform scale of amplification, and systematically arranged in tables, photography would offer an excellent means of faithfully reproducing them.

The introduction gives a history of the development of type plates of diatoms, the first one being produced by Mr. Möller in 1867 and it was sent to the famous algologist, Dr. L. Rabenhorst, for identification. The preparation of similar plates, but on a vastly larger scale, has been Möller's life-work. Of the more famous specimens of his skill, a slide containing 720 separate species of diatoms for the Army Medical Museum at Washington was prepared in 1869, one of 860 for Columbia College, New York, in 1870, and one of 1,715 for Councillor de Capanema of Rio Janeiro in 1880. This last was intended as a present for the late Emperor of Brazil. All these specimens of the minute pale before Möller's last great microscopical slide, where, in a square of about a quarter of an inch, he has in nine divisions and 133 continuous rows the enormous number of 4,036 different diatoms, and with the aid of the catalogue each individual can be selected and identified.

MICROSCOPICAL SOCIETIES.

SAN FRANCISCO, CAL.—GEORGE OTIS MITCHELL, *Sec'y*

February 15, 1893.—The attendance of members and visitors was large, and the meeting was informal. The Corresponding

Secretary read a translation of the "Introduction to Möller's Diatom Plates," recently made by President Breckenfeld, and later a paper prepared by A. Edwards, M. D., of Newark, N. J., a corresponding member of the society, entitled "Marine Fossil Diatomaceæ from California and Their Geology."

The paper stated that the first fossil diatomaceous material discovered in California was collected in 1853 by Washington Chilton from outcroppings on the shore of Suisun bay, about thirty miles from San Francisco. This was sent to Dr. J. R. Chilton, of New York, who in turn placed it in the hands of Professor J. W. Bailey for examination. It abounded in numerous species of *Coscinodisci*, *Actinocyclus*, *Actinopterychi*, and other discoid forms, and was in its general characteristics not unlike the deposits of Maryland and Virginia.

In 1877 Dr. Edwards took up his residence in Berkeley, and as an assistant to the State Geological Survey of California he had ample opportunity for collecting and studying the various deposits of diatomaceous or infusorial earths found in this State, many of which have a world-wide reputation and are of great scientific interest. The paper gave a detailed description of all the more notable deposits, and is supplemented by a complete list of all the species identified in fossil marine genera. This is further enriched by references to authors who have written on or figured these interesting plant skeletons. Dr. Edwards places these various deposits in the oligocene, half way between the miocene and eocene.

After the reading of the papers the society took up the subject of balsam mounting of microscopic preparations, and a general discussion of the various methods adopted by each followed. This proved both interesting and profitable.

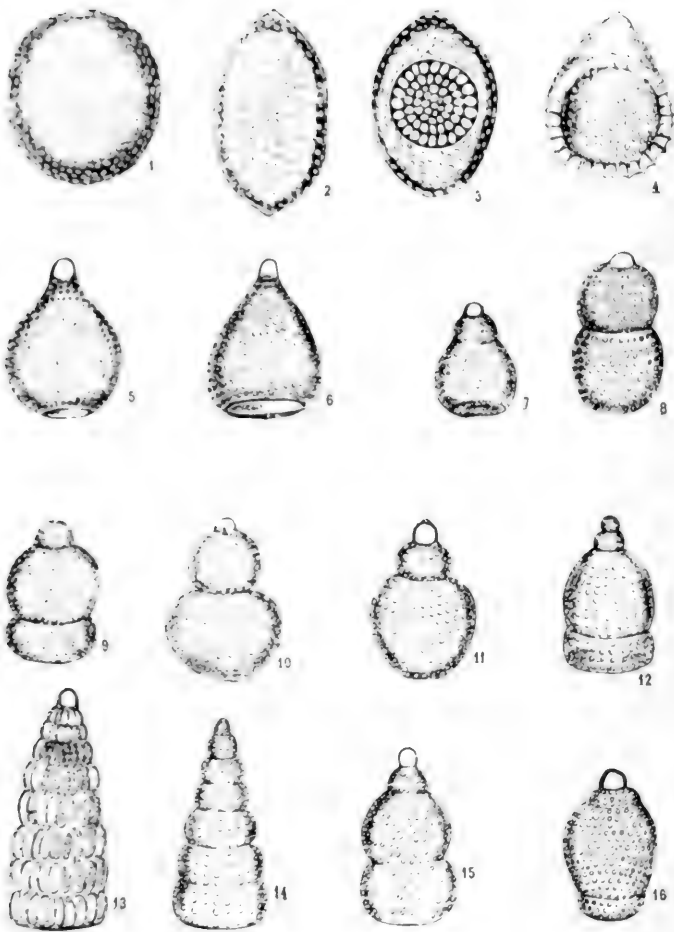
NEW PUBLICATIONS.

Lehrbuch der Histologie. By Prof. Philipp Stöhr. 5th ed. Svo. Jena.

This revised edition contains many illustrations and the latest results. It ought perhaps to be translated into English. The descriptions are full and clearly written. Especial attention is given to making preparations.

Medical Microscopy. By Frank J. Wethered. 12mo. Philadelphia. P. Blakiston, Son & Co., 1892. pp. 406, cuts 101.

A book so clear and concise as this, so compact and so essential to the practitioner, ought to sell by the hundred thousand. How a physician of to-day can practice medicine intelligently without such knowledge as this book contains is incredible.



RADIOLARIA FROM MANITOBA.

THE AMERICAN

MONTHLY

MICROSCOPICAL JOURNAL.

VOL. XIV.

APRIL, 1893.

No. 4.

Some Radiolaria from Manitoba - Mostly New.

[Abstract from a report of the Canadian Geological Survey.]

WITH FRONTISPIECE.

Of 16 species herein enumerated, 13 are new and have been described by Dr. Rüst, of Hanover, Germany. They come from a locality situated on the south side of the gorge of Bell river, in the eastern face of Porcupine mountain, near the extreme northwestern corner of Manitoba (north latitude $52^{\circ} 35'$, west longitude $101^{\circ} 8'$).

At an elevation of 1,450 feet above the sea, on the north side of the river, a somewhat slidden hillside shows, to a height of thirty feet, a scarped face of dark gray clay shales, representing a horizon very near the base of the Pierre formation. Thirty-five feet higher up the bank, and on the south side of the river, is an outcrop of light gray hard siliceous clay shale, associated with a few dark nodules of ironstone. Specimens of this shale were collected and brought to the Museum of the Geological Survey at Ottawa, and on being submitted to a microscopical examination were found to contain large numbers of well-preserved Radiolaria.

The geological formations contiguous have been described by Prof. J. B. Tyrrell in the same report. The following brief descriptions and figures will be sufficient for identifying the species. The dimensions of each species are also published in the report. The classification is as follows:

Family: LIOSPILERIDA.

1. *Caryosphaera æquidistans*, *n. sp.* Very rare.

Family: ELLIPSIDA.

2. *Cenellipsis hexagonalis*, *n. sp.* Not frequent.

Family: DRUPPULIDA.

3. *Prumulum calococcus*, *n. sp.* Rare.

Family: CYRTOCALPIDA.

4. *Cyrtocalpis crassitestata*, *n. sp.* Not frequent.

Family: SETHOCYRTIDA.

5. *Dictyocephalus microstoma*, *n. sp.* Frequent. 6. *Dictyocephalus macrostoma*, *n. sp.* Very frequent.

Family: THEOCYRTIDA.

7. *Theocampe sphaerocephala*, *n. sp.* Not frequent. 8. *Tricolocapsa salva*, *Rüst.* Frequent. 9. *Tricolocapsa thoracica*, *n. sp.* Not frequent. 10. *Tricolocapsa dowlingi*, *n. sp.* Not frequent. 11. *Tricolocapsa selwyni*, *n. sp.* Not rare.

Family: LITHOCAMPIDA.

12. *Dictyomitra canadensis*, *n. sp.* Not frequent. 13. *Dictyomitra multicostata*, *Zittel.* Frequent. 14. *Dictyomitra polypora*, *Zittel.* Frequent. 15. *Stichocapsa tyrrelli*, *n. sp.* Not rare. 16. *Stichocapsa dawsoni*, *n. sp.* Not frequent.

The first species belongs to the order SPHEROIDEA; the second and third to the order PRUNOIDEA, and all the others to the order CYRTOIDEA.

1. *Caryosphæra æquidistans*, *n. sp.*—Shell composed of five concentric spheres, two medullary and three cortical, each with about equal radial proportions. All the spheres with regular, circular pores, two to four times as wide as the bars, increasing in size from the centre towards the smooth surface.

2. *Cenellipsis hexagonalis*, *n. sp.*—Ratio of the longer axis to the shorter, 2:1. Pores regular, circular, about as wide as the bars, thirteen to fifteen on the half equator. The perimeter of a longitudinal section is roundish hexagonal. Surface smooth.

3. *Prunulum calococcus*, *n. sp.*—The ellipsoidal cortical shell thin-walled, smooth, with regular circular pores, about as wide as the bars. Ratio of the major axis of the ellipsoid to the minor, 3:2. Both medullary shells large and spherical, with large circular pores.

4. *Cyrtocalpis crassitestata*, *n. sp.*—Shell infundibuliform, very thick, with regular circular pores of equal size, and about as wide as the bars. Mouth large, simple, wider than the length of the shell. Surface smooth.

5. *Dictyocephalus microstoma*, *n. sp.*—Shell thin-walled, smooth, collar stricture not apparent. Cephalis subspherical, hyaline, without pores. Thorax inflated, subspherical, with regular circular pores, about as wide as the bars, in twenty oblique rows. Mouth constricted, only one-third as wide as the thorax, without peristome.

6. *Dictyocephalus macrostoma*, *n. sp.*—Shell thin-walled, smooth, without collar stricture. Cephalis subspherical, hyaline, without pores. Thorax roundish, urceolated, with regular circular pores, about as wide as the bars, in fifteen to

sixteen oblique rows. Mouth less constricted than in the former species; two-thirds as wide as the thorax, without peristome.

7. *Theocampe sphærocephala*, n. sp.—Shell wide, bottle shaped, thin-walled, with two distinct strictures. Cephalis spherical, hyaline, without pores. Thorax campanulate, with three transverse rows of circular pores. Abdomen inflated with from eight to nine obliquely descending rows of circular pores. Mouth but little constricted, two-thirds as wide as the abdomen. Ratio of the three joints to each other: length, 1:2:4; breadth 1:3:6.

8. *Tricolocapsa salva*, Rust.—Shell slenderly ovate, with two slight strictures. Thorax of about the same size as the abdomen. Relative lengths of the three joints, 1:3.5:4; relative breadth, 1:3:3.5. Cephalis flat, hemispherical, hyaline, without pores. Thorax spherical, with subregular, circular, unequal pores. Abdomen broad, ovate, with larger, regular, circular pores, in from nine to ten transverse rows. Surface smooth.

9. *Tricolocapsa thoracica*, n. sp.—Shell ovate, smooth, with two distinct strictures. Relative lengths of the three joints, 2:5:3, relative breadths 2:5:5. Cephalis, hemispherical, with from three to four transverse rows of small circular pores. Thorax subspherical, with from nine to ten transverse rows of larger, regular, circular pores. Abdomen broad, hemispherical, with from four to five transverse rows of pores of the same size.

10. *Tricolocapsa dowlingi*, n. sp.—Shell ovate, smooth, with upper slight, and lower deep stricture. Relative lengths of the three joints, 1:4:6; relative breadths, 1:3:5. Cephalis, hemispherical, hyaline, without pores. Thorax quite spherical, with from seven to eight oblique rows of large circular pores, twice as wide as the bars. Abdomen subspherical, compressed, with from ten to twelve transverse rows of distant, smaller circular pores.

11. *Tricolocapsa selwyni*, n. sp.—Shell wide, bottle-shaped, smooth, with two distinct strictures. Relative lengths of the three joints, 1:2:4; relative breadths, 1:2.5:6. Cephalis small, ovate, hyaline, without pores. Thorax hemispherical, with four transverse rows of circular regular pores. Abdomen large, inflated, spherical, with from ten to twelve transverse rows of pores of equal size.

12. *Dictyomitra canadensis*, n. sp.—Shell short, conical, campanulate, smooth, with three distinct strictures. Cephalis small, spherical. Thorax small, hemispherical, with three transverse rows of circular pores. Abdomen with two joints; the upper large, inflated, with eleven transverse rows of circular, regular pores row the lower joint ring-shaped, with four transverse rows of pores of the same size. The wide, open mouth without peristome. Relative joints of the four joints, 1:1:5:2; relative breadths, 1:1:5:5.5.

13. *Dictyomitra multicostata*, Zittel.—Shell slender, conical, with prominent longitudinal ribs, and from eight to ten deep strictures. Length and breadth of the joints gradually increasing, the eighth joint being twice as long and broad as the fourth joint. Pores regular, circular, one series in each longitudinal furrow, three to four pores in each joint.

14. *Dictyomitra polypora*, Zittel.—Shell slender, conical, rough, with six to nine deep strictures. Length and breadth of the joints gradually increasing, so that the eighth joint is twice as long and broad as the third. Pores regular, circular, in transverse rows in each joint, the last joint having from five to six rows.

15. *Stichocapsa tyrrelli*, n. sp.—Shell smooth, slender, pear-shaped, twice as long as broad, with three deep strictures. Relative lengths of the four joints, 1 : 1.3 : 4 : 3; relative breadths 1 : 2 : 5 : 5.5. Cephalis spherical, hyaline, without pores. Thorax hemispherical, with four transverse rows of regular, circular pores. The fourth joint is the broadest, but is shorter than the large campanulate third joint. Pores in the second, third, and fourth joints of equal size, and all about as wide as the bars.

16. *Stichocapsa dawsoni*, n. sp.—Shell smooth, irregular, ovate, with three internal septal rings, without external strictures. The third joint is the largest, being more than half as long as the shell. Relative lengths of the four joints, 1 : 1 : 5 : 1; relative breadths, 1 : 2 : 4 : 3. Cephalis hemispherical, hyaline, without pores. The second and fourth joints small, with three transverse rows of regular, circular pores. The third joint ovate, with truncated poles, and from twelve to thirteen transverse rows of subregular, circular pores.

Biological Descriptions of Certain Common Hydroid Animals.

By H. L. OSBORN,

ST. PAUL, MINN.

(Continued from page 69.)

POLOCORYNE CARNEA ?* (figs. 17-18).

This is a marine animal. It lives attached to the shell of the spider-crab, *Libinia canaliculata*, in the muddy, shelly bottoms

- * BELLING.—1. Claus Sedgwick, Text-b. Zool., vol. i, p. 237.
- 2. Lankester, E. Brit., ix, p. 560.
- 3. Gegenbaur, Comp. Anat., p. 94.
- 4. Parker, Elementary Zoology, p. 236.
- 5. Lang, Text-Book of Zoology.
- 6. R. Manes, Jellyfish, Starfish, etc., p. 10.

EXPLANATION OF FIGURES OF POLOCORYNE.

Fig. 17. *Polocoryne*, from nature, showing the reproductive person with the manubrium and tentacles, and the clustered medusa buds in various stages of development, showing the rhizoid, or stolon attached in this case to the shell of the spider-crab.

Fig. 18. *Polocoryne* from nature, the medusa; rv, radial vessel; vel, velum; S.ku, sensory organ at base of tentacle, eyespot; mar. ten., marginal tentacles in two sets, four shorter; man, the manubriums inside the bell; or, the ovary in the ectoderm on the manubrium.

of sounds and bays of the North Atlantic coast of the United States. In the air it appears like a grayish scum, but when the crab is immersed in water it forms a soft gray velvety layer, composed of the bodies of multitudes of Hydra-like members, collectively forming a colony. The single members of the colony (see fig. 17), called *hydrozooids*, bear considerable resemblance to Hydra, having a tubular body with manubrium and tentacles and central mouth, but there are no gonads nor any lateral hydra-form buds, and the body is attached below to a sort of runner or *stolon*, which, by its budding, builds up the colony, the buds as they form not separating from the parent stock as in Hydra. The zooids and the stolon are both cellular and composed of ectoderm and endoderm layers. Both are hollow, and thus all the members are in open connection for purposes of circulation. The zooids are of two sizes and kinds; some larger ones (not shown in the figures) do not bear any buds, and are solely the gatherers of food for their own use and for the use of the colony; other (fig 17.) smaller ones are, besides being feeding zooids, capable of producing lateral globular buds, called medusa-buds or *gonozooids*, because they are to contain the *gonads*. The gonozooids when ready to leave the hydrozooid stock that formed them is a bell shaped gelatinous body (fig 18.)* with a *manubrium* hanging down inside and with the rim nearly closed by a thin membrane, the veil or *velum*, which has a circular opening in the centre. The margin of the bell is furnished with eight tentacles at regular intervals, four longer and four shorter, at the base of each one of which is a bright colored spot, believed to be somewhat sensitive to light. The ectodermal part of wall of the bell is highly contractile muscular cells, and from its shape determines that its vigorous contractions shall force a jet of water out through opening in the centre of the velum, the reaction of which propels the bell in the opposite direction. The gonozooids, or, as they are more commonly called, *medusæ*, as they develop, free themselves from the parent body by these contractions of the bell and then swim independently through the water by the same aid and cease to have any physical relation to the colony which produced them. The manubrium is, like that of Hydra, pierced in the centre by a mouth surrounded by tentacles and hollow within. At the base of the manubrium four *radial tubes* or vessels run out through the substance of the bell into the four larger tentacles, and a *circular tube* runs about in the margin of the bell and places all the *radial tubes* in communication. The bell is covered inside and out with ectoderm; the velum is also ectodermic, and the tentacles and manubrium are covered with it. The inside of the manubrium is endodermic, as are the radial and circular vessels and the inside of the tentacles. The substance of the bell is mainly non-cellular gelatinous matter. The ectoderm at the base of the manubrium is thickened in four

* See Parker, p. 235, fig 54.

places: these are the gonads—male or spermaries, and female or ovaries—and the sexes of the Podocoryne are separate. The eggs are set free in the water, where, if they are fertilized, they develop through stages similar to those of Hydra, and a smaller hydra-form embryo finally forms, which attaches itself and forms a new colony by the asexual process of budding. Where two quite unlike forms, like the hydrozoid and gonozooid, occur in an animal life history, and where the sexual and asexual process of reproduction alternate, it is called an *alternation of generation*, the eggs not being produced directly by the individuals which grew from eggs, but from a generation of individuals produced asexually from those produced from the egg.

HYDRACTINIA ECHINATA.* (fig. 19).

This marine hydroid forms a pinkish film on the shells of snails, *e. g.*, *Lunatia* tenanted by hermit-crabs. It is a polymorphic colony—that is, a colony composed of several kinds of zooids or members; these are first the stolon or spreading network of tubes of ectoderm and endoderm, which, by budding, give rise to the entire colony; then there are the feeding zooids or nutritive polyps, which compare closely with Hydra or Podocoryne, being tubular, terminated with tentacles surrounding a manubrium, also the *dactylozooid* or protective person, which has no mouth or tentacles, but is very mobile and sensitive, and, moreover, is armed with a very formidable array of nettle-cells, and also the generative zooid, a stem terminated with nettle-cells but bearing on its sides numerous large spherical bodies which contain ova; these are believed to be degenerate medusæ, comparable with the gonozooids of Podocoryne. There are no medusæ, but the eggs are set free in the water from the generative zooid; there is thus, in this case no true alternation of generations. Hydractinia has a skeleton surrounding the stolon at the base of the colony and projecting in the form of hard spiny prominences which must offer perfect protection to the stolon and considerable protection to the zooids when they are contracted to their utmost. In this case we can see that polymorphism is carried even farther than in Podocoryne.

TUBULARIA DIVISA.†

This is a colony of salt-water hydroids, common in many places on our coast, growing on wharf piles and other submerged objects. It is notable for the large size attained by the zooids, they being often as much as $\frac{1}{4}$ inch across. There are distinct stems,

* Lankester, E. Brit. ix., p. 561.

Agassiz, Seaside Studies, p. 73.

Packard, Zoology, p. 56.

EXPLANATION OF THE FIGURE OF HYDRACTINIA.

Fig. 19. From nature; part of colony scraped from *Lunatia*, showing the rhizoid or stolon R_z, and its branchings and three forms of persons: nut, the nutritious person; dac, the dactylozooid or sensory and killing member, and med, the medusa producing poison; in this case the medusæ are rudimentary, and do not become free.

† Agassiz, Seaside Stud., p. 72. Riverside Natural History, vol. i, p. 80.

long and somewhat wavy and sometimes slightly branched, arising from a ramified basal stolon and shielded with a chitinous external shell; the stems are terminated above by the zooid, which is never covered by any skeleton, the cuticle of the stem stopping short at the base of the zooid. The zooids of the colony are all alike and there is no polymorphism. Each zooid presents a broad basal portion bearing numerous basal tentacles in a circle. Within them is the pear-shaped body at whose base are minute stems bearing numerous spherical *medusa* buds, and at whose summit is the mouth, surrounded by a number of short oval tentacles. The body and stalk are both composed of cells arranged in two layers, as in the other cases already described. The medusa buds become separated from the colony, not, however, in the form of a swimming bell, as in *Podocoryne*, but in a peculiar creeping form known as *actinula*, and from this the egg development takes its start.

OBELIA DICHOTOMA* (figs. 20, 21).

This, a graceful hydroid, forming colonies rarely more than an inch in length, covering submerged objects of all sorts in the purer ocean waters, it is one of the common hydroids attached to seaweed on rocky shores of outer harbors. The colony slightly magnified (fig. 20) presents a zigzag stem, bearing alternate zooids. The zooids are very small, much smaller than in *Podocoryne*, etc., but the same structural plan can be detected in them. A main stem runs up from the stoloniferous base, and this stem is a fleshy tube, covered with a horny outer skeleton. This latter is made up of successive joints like each other, but leaning either way alternately. At each joint of the cuticular stem the fleshy tubular stem within gives off a branch which is the special stem of a zooid. This stem is covered by a ringed cuticular covering, terminated with an exquisitely delicate cup, "hydrotheca" or "calyce," into which the zooid can retreat for protection. This zooid is a feeding member (hydrozooid) of a polymorphic colony. It has a circlet of tentacles surrounding a central manubrium. All the fleshy parts of the body are cellular, ectodermal and endodermal, and they differ from *Hydra* in no essential respect, but only in details of form. Besides the numerous hydrozooids there are occasionally borne, at joints of the stem, larger bodies, composed of a vase-shaped cuticle, gonotheca, protecting a delicate stalk within which is open below to the channels of the main stalk and on the side to numerous globular buds, which are medusæ in process of development, which latter are to escape in the water as free medusæ, there to

* BIBLIO.—Brooks, *Inv. Zool.*, p. 39.
Riverside, *Nat. Hist.*, p. 84.
Lankester, *E. Britt.*, ix, p. 560.
Agassiz, *Seaside Stud.*, p. 50.

EXPLANATION OF DRAWING OF OBELIA.

Fig. 20. *Obelia* colony as it appears to the naked eye.

Fig. 21. Small part of 20 highly magnified, showing the chitinous outer skeleton of the main stem and of the zooids, and the two forms of zooids, the nutritive zooid and its cover, the calyce or hydrotheca, and the gonozooid or medusa producing person and its cover, the gonotheca.

reproduce sexually or found other colonies like the one from which they sprang. These medusæ are broad and flat, not bell-shaped, and have no veil, but they have marginal tentacles, radial vessels manubrium, and mouth. (The development of the obelia egg is described by Haddon, Practical Embryology, p. 49.)

SERTULARIA PUMILA.*

Here, as in *Obelia*, we have a colony of extremely minute zooids, the colony itself having the appearance of a plant, whence its name of sea-moss has been applied to it. The colonies are generally found abundantly on the green rock-weeds (*Fucus*), so very numerous on the rocky shores of the New England and Middle States. The colony as a whole is short and usually closely applied to the rock-weed. It consists of a central stem and lateral branches which arise from it and slant away from the base of the colony. The stem appears to be notched; these notches when closely examined reveal the chitinous hydrothecæ, which lodge the extremely small feeding zooids. The cups are sessile on the stem, not stalked as in *Obelia*, and they are opposite each other (they are alternate in *Hydrallmania*), and each one has a little cover, *operculum*, to close the end of the hydrotheca when the zooid is retracted. The feeding zooids are connected by the fleshy main stem, so that, as in all hydroid colonies, the combined product of their digestive processes can form a sort of blood, and circulate throughout the entire colony and supply every member. The colony includes, besides the feeding zooids, fewer gonozooids; these are contained in larger capsules of chitine; they present a stem which produces medusæ by budding. The medusæ, in the case of *S. pumila*, however, and in many of its allies, have no mouth and never become free, but they produce eggs or spermatozoa, and set them free, after which they are of no further use to the colony.

NANOMIA CARA.†

In all the hydroids mentioned up to this point I think any one

- *BIBLIOG.—Agassiz, Seaside Stud., p. 66.
Packard, (*S. abietina*) Zool., p. 61.
S. argentea, Riv. Nat. Hist., p. 86.

EXPLANATION OF THE FIGURE OF SERT. PUMILA.

St., common stem of one of the ultimate subdivisions.
Hy, single feeding zooid, and shows also its hydrotheca; the operculum shows in the one above.

Gon, a gonozooid stem; the sexual buds, and the large gonotheca covering them.

- †BIBLIOG.—Agassiz, Seaside Studies, p. 76.
Lankester E. Brit., ix, p. 564.
Fewkes, Bull. Mus. Comp. Zool., xiii, p. 213.
Huxley, Oceanic Hydrozoa.

EXPLANATION OF FIGURE OF NANOMIA CARA.

From Fewkes with slight changes.

Fl, the float at the closed end of the main stem.

St, the main stem, at the lower end of which is the parent zooid of the colony.

Nc, nectocalyx or sterile bell for swimming.

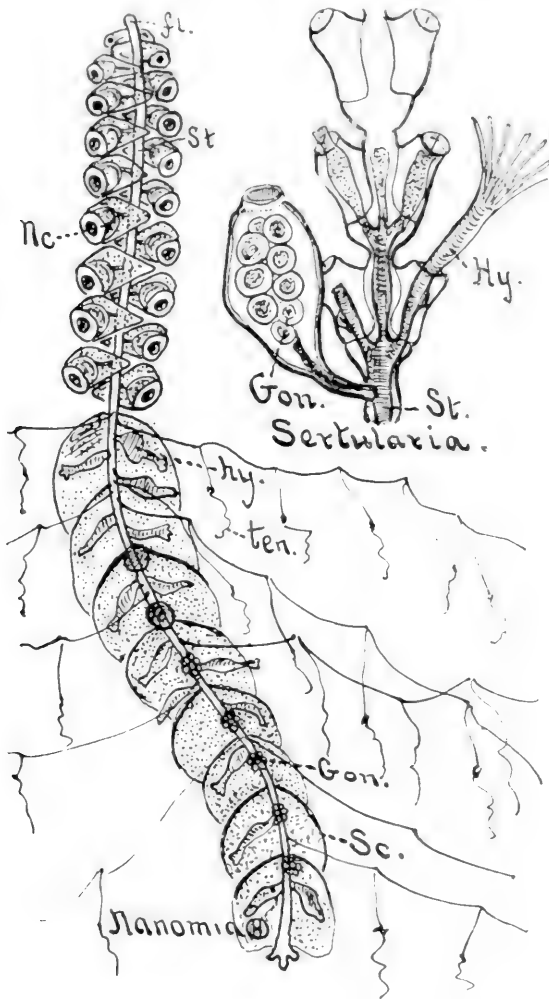
Hy, one of the feeding zooids.

Ten, portion of one of the tentacles.

Gon, gonozooids.

Sc, hydro-phyllum or scale covering the zooids.

would see that the individuality of the colony as a whole is not very prominent, and would think of the colony not as an animal but as a colony of animals, each zooid impressing him by its own individuality. But just as in *Hydra* the individualities of the cells



are lost in the higher unity of the resultant animal, so in hydroid colonies it is possible to find some in which the entire colony is such a unified whole that the separate zooids sink to the level of organs in the higher individuality of the whole organism. This view is very clearly illustrated by *Nanomia*, a member of the

order *Siphonophora*. *Nanomia* is a pelagic organism; that is to say, it is found only in the ocean surface waters, usually out at sea. It is translucent, whitish, with numerous long filaments trailing after a central straight body, which moves forward with gentle impulses. The elongate body is buoyed up by a bubble at one end so as to maintain an oblique but nearly vertical position. It is a hydroid colony. A main stem runs through from the bubble, which equals the base of a fixed colony, to a terminal zooid at the opposite end; just below the float are about 20 sessile medusa-bells which are diverted from their reproductive function and never become free, and their powers of locomotion are utilized for the benefit of the colony as a whole. In return they are relieved of the labor of capturing and digesting food and are supplied from the main stem. These persons are called *nectocalyces*. Below these are located nutritive zooids; these have no tentacles but are hollow tubes with a terminal mouth open below to the main stem, and their exclusive function is to digest food which is captured for them by the long tentacular streamers armed with formidable nettle-cells which reach out over a considerable area and sweep into their destruction innumerable denizens of the surface water of the ocean to be the food of the colony. The base of the tentacle and feeding persons are covered by broad thin *shields* which are so placed as to lap over each other from above downward. The main stem carries modified medusæ which produce the generative elements and throw them off into the water, where they develop and form new colonies. *Nanomia* is thus comparable with an entire colony of other hydroids, and yet its individuality is such that we are not so likely to notice it as a colony except as we compare it through a series like that we have been considering. Other forms of Siphonophores are even more highly specialized so that their colonial derivation is even less easily discernible, such, for instance, as the beautiful *Porpita* and the Portuguese man-of-war.

A Sliding-Carriage and Stage for the Microscope.

By GEO. WHITFIELD BROWN, JR.,

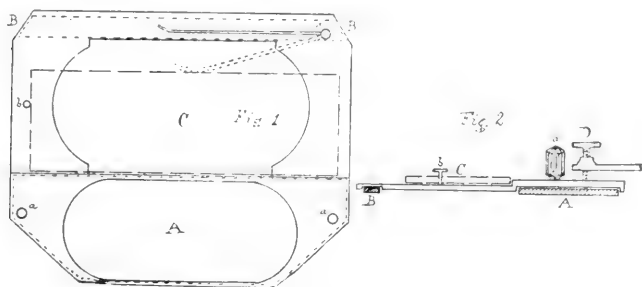
NEW YORK.

The following description and drawing of plan and section of an improved sliding-carriage and stage for the microscope may be of interest. If put into actual use it will, I hope, bring as much comfort and satisfaction as it has brought to me.

After considering the qualities useful in a good stage, Dr. Dallinger concludes (Carpenter, 7th ed., p. 169) that an efficient substitute may be found for a mechanical stage in what he terms a "super-stage," so arranged that the bearings shall be glass, and friction reduced to a minimum. He says that "against its employment is the fact, first, that the slide is clipped into a rigid

position; and, second, that the aperture is too small to admit of the employment of the finger in moving the slide to assist in rapid focusing." He adds: "But these are defects which might certainly be overcome."

The improved "super-stage" now described is believed to obviate these objections, and is not only "an efficient substitute" for a mechanical stage, but a most desirable substitute for usual work with the microscope; permitting, as it does, absolute freedom of movements about a field for full two inches horizontally and one inch vertically, thus allowing ample room for even serial sections; and possessing, as it does, exquisitely smooth sliding movements, over the stage proper of the microscope, of almost absolute precision. My carriage and stage, made for me a year ago by Zentmayer of Philadelphia, after my own specifications, is of such excellent workmanship as to give perfectly level and precise movements under a power of 2,250 diameters (Zeiss 1-12 homo. immers. x 18 compens. ocular).



The drawing shows in Fig. 1 a plan of the sliding-carriage, and in Fig. 2 a cross-section on a vertical central line. The stage should have two flat rails, one on each side of its aperture, slightly raised above the surrounding surface, on which the carriage slides; and the stage may be square or round in shape, as preferred. The outlines of the carriage are shown by the full lines of the figures. Affixed to the bottom of the carriage are glass rails *A* and *B*, of which the outlines and positions are indicated by dotted lines. These glass rails of the carriage slide on and over the metal rails of the stage. The circles *aa* and *b* show respectively knobs for hold-fasts and a centring-stop for object-slide *C*, indicated by the broken lines of the figures. A spring clip, *c*, is provided, which can be swung against the upper side of the slide, as indicated by dotted lines in Fig. 1, to hold it securely in place when the stage is perpendicular or while it is rotated, or swung aside out of the way as shown by full lines. The slide rests with sufficient security against the ledge of the carriage when the stage is level or inclined, free from being clipped in a rigid position, justly criticised as

objectionable by Dr. Dallinger. The carriage is kept in contact on the rails of the stage by the spring and ivory-pointed thumb-screw *D*, and the pressure thereby regulated. It will be observed that there is ample room in the opening of the sliding-carriage, above the object-slides, to insert the end of the forefinger in quick focusing as recommended by Dr. Dallinger and practised by many microscopists; and also that the object-slide is not clipped in a rigid position, but can be when desired. This opening also permits the use of wide angle, short focus or immersion substage condensers. By placing the forefinger on the hold-fast *a*, the middle finger on the post of the spring-clip *c*, and the thumb against the lowest corner of the sliding-carriage, an object can be moved around and about the whole field of view with the greatest facility and precision and perfect control, while the other hand is constantly used at the same time in adjusting the focus as desired. Personally, I think such a carriage should be as light as possible consistent with sufficient rigidity in construction. My own weighs only a little over one ounce; the brass part, supporting the object-slides *C*, being 1.25 inch thick, and that holding the broad glass rail *A* double that thickness. The ledge against which the object-slides lie should, I think, be lower than their average thickness, to permit passing under high-power objectives so as to allow examination even to the extreme edges. The ledge of my own carriage is 1.25 inch high, and I find this ample to securely support ordinary object-slides, and low enough to pass under the highest power objectives.

Report of Division of Microscopy, Agricultural Department, for 1892.

[Extracted from the Report of the Secretary of Agriculture.]

During the past year this division has been largely engaged in collecting specimens of the edible and poisonous mushrooms of the United States and Territories, which are intended for exhibition, collectively, at the World's Columbian Exposition. In this work the division has had the cordial assistance of the agricultural experiment stations of the country, and upwards of six hundred models have been made of individual specimens in this collection. The models will be colored from nature, and grouped and classed according to their edible or poisonous character. The groups, as a whole, will illustrate in miniature a forest scene, and indirectly will show some of the permanent causes of forest decay.

In consequence of the increased demand by the public for information relating to the cultivation of edible mushrooms, this subject has received continued attention, and new illustrations

will be published from time to time showing the latest discoveries in this direction.

In the prosecution of experiments upon the oils, butter, and other fats, a new device connected with the microscope has been invented during this year, which promises to be of great value in the detection of adulterations of food fats and medicinal oils, such as have hitherto escaped detection.

New and important experiments have also been made in connection with silver nitrate as a test for adulterated food, medicinal or other oils, such as cotton-seed, olive, castor, linseed, etc., with well-defined results, which will be illustrated in the forthcoming report, showing the relative reactions of the silver nitrate and the respective oils. Further experiments are also in progress relating to the testing of farmer's binding twine, pure and adulterated. Samples of cotton for microscopical examinations have been received from nearly every cotton-growing country in the world, as also a large assortment of animal fibres for examination and comparison.

A Cement which Promises to be of Value in Microscopy.—It has long been known that glycerin and litharge make an excellent cement for many purposes, and the writer suggested its use in microscopy in the *National Druggist* as far back as 1884. Some months ago he had occasion to build some deep cells for opaque objects, and used the lead cement for the purpose. Up to the present time the cells seem to be all that could be wished. The following is the method of preparing the cement: Take any convenient quantity of litharge and reduce it to an impalpable powder by porphyzation. Place the powder in a crucible and expose to a bright red heat for some time. Keep this powder in closely-stoppered vessels. When needed for use mix with sufficient anhydrous glycerin to make a paste, and with the paste quickly form your cells by the aid of a penknife and the turn-table, using the latter as a potter's wheel is used, forming up the sides of the cell by gentle pressure from the knife-blade. This cement hardens very rapidly, resists almost all fluids, even mineral acids, and does not shrink appreciably in drying. It is not affected by any degree of heat short of the boiling-point of glycerin. It adheres most firmly to any surface to which it may be applied, and can thus be used for cementing almost all kinds of substances—metal, porcelain, glass, etc. Only a small amount of the litharge and glycerin should be mixed at a time.—*National Druggist*.

To Fix Paper on Glass or Metal.—The *Revue Photographique* gives the following, which is said to be excellent: Mix 30 gm. tragacanth and 120 gm. gum arabic, and dissolve in 500 gm. distilled water. Filter and add 2.5 thymol dissolved in 120 cem. glycerin.

Method of Demonstrating Living Trichinae.

BY ALGERNON S. BARNES, JR., M. D.

ST. LOUIS, MO.

The living trichina, or pork worm, makes an attractive slide, and never fails to attract attention. An old cat or rat is killed, and the muscle from between the ribs, also the diaphragm and muscles of the thigh, are extirpated. A piece is nipped from each of the specimens, and placed between two slides, which are pressed together and examined under the microscope with about a one-inch objective.

If the trichinae are found to be present in their cysts, a piece of the muscle the size of a pea is placed in the following solution in a small bottle:

Pepsin,	.	.	.	.	gr.	111
Water,	.	.	.	.	5	11
Hydrochloric acid,	.	.	.	.	m.	11

As this is to duplicate the process of digestion, the fluid must be kept at body temperature, preferably in the pants pocket, or in a warm oven. The fluid is to be shaken every little while; in about three hours, sometimes less, the meat will be dissolved, as well as the cyst which contains the trichinae. The fluid is then poured into a conical-shaped glass to allow the trichinae to settle to the bottom, which operation will consume about ten minutes. A pipette is then introduced into the glass near the bottom, and the contents placed in a glass cell, which should be large. This cell is then placed under a dissecting microscope, and the trichinae taken out by means of a pipette and placed in clear water. They are again picked out of the clear water by the same method, and placed in a drop of pure water in the centre of a glass, cement cell, or in a live-box, and a few minutes allowed for the worms to settle to the bottom. A cover is now put on and sealed with white vaseline. It is now ready for examination on a hot stage under the microscope, where the worm may be enlivened at will by the heat.

I have found that about three trichinae in a cell are sufficient, for when they get lively they are hard to keep in the field and in focus. If a permanent mount should be wanted of isolated worms they are finally placed in a drop of glycerin instead of water in a cell and sealed with cement. The worms will be found uncurled in the glycerin, which kills them.

The meat may be kept in pure glycerin for several years, but of course the worms will be dead and may be dissolved out by this process.

An Aluminum Microscope.—A microscope recently made of aluminum weighs only 2 pounds 10½ ounces. The screws are of brass, the fine adjustment of steel, and the nose-piece of German silver. The same instrument in brass weighs 7 pounds 13 ounces.

Seeds of Mullein (*Verbascum thapsus* L.).

By R. H. WARD, M. D.,

TROY, N. Y.

(From Note-book Q of the American Postal Microscopical Club.)

"These seeds are rather pretty" says one. Well, that is good. But to persons thoughtful enough to go beyond this quite obvious reflection they suggest questions of much greater interest. Giving, as mounted, no views of internal structure, their study presents the problem of the fitness of the ripe seeds, as we see them here, to secure the success of the plant in perpetuating and spreading the species, and to account for its decidedly peculiar habits.

This common Mullein is one of the most inveterate, not to say triumphant, of weeds. It does not lurk about thickets or partly inaccessible regions, but boldly and rapidly spreads over pastures and waste places whenever it has a chance. From its great size and conspicuous bearing, this worthless intruder is easily exterminated by the careful and thrifty farmer; but it quickly overruns half-cultivated fields, and becomes an intolerable nuisance and a conspicuous disgrace to negligent or slovenly cultivators, often taking possession of whole fields for a succession of years. Though evidently a naturalized foreigner, from Europe, it prospers in a style that shows it well adapted to the conditions here; and in fact it makes itself at home, like some other alien citizens, with a boldness and arrogance somewhat in proportion as it is undesirable and unwelcome.

Many a plant prospers greatly, by reason of possessing some one valuable adaptation: but in this case there is no difficulty in seeing reasons by the half-dozen, any one of which would give it more than a fair chance in the competition for place. Its biennial habit enables it to get a sufficient start at almost any time, place, or season, and to be ready for a vast amount of flowering at the first opportunity. Its hard, stout, erect stalk, and big, clumsy leaves, protected by a nauseous if not poisonous juice within, and by a thick and almost impenetrable coat of woolly hairs (well known to microscopists) without, are nearly proof against the force of wind and storm, the tramping and browsing of cattle, and even the attacks of insect pests. The large, showy spike of gaudy flowers, highly specialized also in form as well as color, places the herb, notwithstanding the farmer's contemptuous name of weed, far up among the higher ranks of insect-fertilized plants.

Lastly, here are the seeds: (*a*) produced in immense numbers; (*b*) of small size, wasting no unnecessary material, small enough to sow themselves easily in the crevices of the neglected soil where they thrive, and just large enough to sprout successfully during the short time required to take root in such places; (*c*) with a horny external coat, furnishing a maximum of mechanical protection from external injuries, and probably able to resist

the digestive action when swallowed by birds; and (*d*) of a dull, brownish color and minutely furrowed surface presenting a remarkably sandy aspect when seen without the microscope.

What is the significance and the cause of evolution of these last features, which constitute the principal microscopical peculiarities of the specimen? Apparently they must be related to the dissemination by agency of birds, and in this respect they may be important in either one of two exactly opposite ways. The obscure and sandy appearance would evidently render it difficult for the birds to find and carry off the seeds sufficiently to prevent crowding in the immediate neighborhood; and this may account for the habit of the plant to overstock, to an exceptional degree, fields in which it has become established. On the other hand, they seem adapted to bird-dissemination to a moderate degree; and the extent to which this actually occurs and is of service to the species is an interesting question for future investigation.

Fruits that are highly specialized for bird-dissemination, such as most of the familiar berries, are large enough to be easily found and to be worth the trouble of eating, and are of showy colors, red, which seems specially attractive to birds and to some other fruit-eating animals, blue, blackish, or white. A few handsome and showy seeds appeal likewise to the vision of the birds; but being hard and probably not digestible they have been considered unserviceable to the birds, and attractive only to young and inexperienced ones that had not yet learned their uselessness, and that are, therefore, by misapplying the teachings of instinct that attractive-looking fruits are good to eat, easily duped into taking and swallowing what will prove useless to them. But is there any proof of this in the known facts, and is it probable that the instinct of the birds would be thus misled sufficiently to cause the high degree of specialization already attained in such seeds? I think not. It seems far more likely that the birds, not misguided, but led by a true instinct, swallow these hard morsels not as food, nor in vain, but as mechanical aids to digestion, as birds are known to do in some cases, having learned by experience that the nourishing food serves them better in such company. This theory would account for the swallowing of these indigestible morsels, even when, as in the present case, they do not look like edible berries, and also for the evolution, as yet unexplained, of the granular-looking surfaces variously wrinkled, furrowed, honeycombed, pitted, tubercled, or spiny, that ornament many kinds of minute seeds and make them favorite microscopic objects. In case of tiny birds, at least, the minutely-roughened surface would add perceptibly to the value of these insoluble particles as triturations or local irritants, while the sculpturing of the surface may even assist somewhat in finding and recognizing the objects. These details are probably more visible to a bird closely searching for food than to our more distant view, since the size of the retinal image would increase rapidly with the nearness of the eye to the object.

Flexible Sandstone.

By R. D. OLDHAM,

CALCUTTA, INDIA.

[Abstracted from an address before the Microscopical Society.]

The cause of the flexibility is evident at once if the rock is examined under the microscope; in fact, it may be detected in the coarser-grained specimens with no more powerful magnifying power than is furnished by a Coddington lens. If the rock is examined under a low power by reflected light, it will be seen that the rock is of a cavernous nature and composed of irregular-shaped fragments, each of which is loose and can be moved backwards and forwards slightly with a needle point; in fact, the rock is composed of a number of granules, each perfectly detached from its neighbors, and each possessing a certain amount of freedom of movement, owing to the intervening space. It is quite obvious that a rock of such constitution would have just such a freedom to alter its shape, within certain limits, and not beyond them, as is possessed by these specimens, and all that remains to be explained is how these separate granules manage to hold together.

Turning now to the transparent section of the same rock it will be seen that the outline of the individual granules is very irregular, and occasionally projections on one granule will be seen inserted into recesses in an adjoining one. In fact, the rock resembles one of those toys where a picture pasted onto a thin piece of wood has been divided up by sinuous cuts of a fret-saw into a number of irregular-shaped pieces. When these are properly fitted together again the slab and picture hold together as a whole, and can be pushed or pulled about on the surface of the table, but it is no longer solid, and within certain limits can be stretched, shortened, or have its shape distorted, just as is the case with our flexible sandstone. The only difference is that the projections and recesses, instead of lying all in one plane, are in every direction and on all sides of the granules composing the rock; hence it is that in the thin section we only occasionally see an actual case of interlocking, for only those projections which lie in the actual plane of the section remain, all the others having been ground away.

How did this structure arise? The first thing to notice is that the flexible stone is essentially a product of the decomposition of rock which exhibits no such character. This is certainly the case as regards the Indian specimens, and the same has been noticed in the case of both the North and South American localities, where a similar rock has been observed. At Kalia the undecomposed condition of the rock is a hard glassy quartzite, a thin section of which is exhibited, and it will be seen that the rounded grains of sand, which formed the rock in its original condition, have changed their shape under the influence of heat and pres-

sure, aided by secondary outgrowths of quartz, optically continuous with the original grains, till it is now composed of irregularly-shaped granules of quartz for the most part in close contact with each other, but intermixed with a small proportion of a felspathic paste. This paste yields more readily to the action of weather than quartz, and, though weathering does doubtless also take place along the junction surfaces of the individual grains of quartz, the disintegration of the rock appears to result almost entirely from the decomposition of the felspathic paste. In such a rock the development of flexibility will depend on the proportion and distribution of the felspathic paste. If this be absent or only present in small proportions, decomposition will not extend to any depth, and there will be a mere film of decomposed stuff on the surface of the undecomposed rock; if it is too evenly distributed, the individual grains of quartz will not be in sufficiently intimate contact with each other, and the rock will weather into a fine sand, easily washed away; if finally it should be suitably distributed, but too great in amount, the voids left by its removal will be so large that the quartz aggregates will not interlock with each other. The number of conditions that must be fulfilled accounts satisfactorily for the rarity of flexible sandstone, and for its capricious distribution in rocks that have to all appearances the same composition and structure.

In 1871 Mr. Fedden found at Charli, south of the Penganga river in Berar, a rock which exhibits the same sort of flexibility as that of Kaliana, but differs widely from it in every respect except that it is now, what the other once was, a sandstone. Instead of being composed almost entirely of quartz and owing its cohesion to the metamorphism it has undergone, it is an ordinary unmetamorphosed calcareous sandstone, at first sight not remarkable for anything but its softness, and the large proportion—over 35 per cent.—of carbonate of lime it contains; but a closer examination will show that the calcareous cement has become crystallized, and that the rock is now in reality composed of crystals of calcite some $\frac{1}{4}$ -inch in diameter which include the odd 65 per cent. of quartz and other granules as so much extraneous matter. Microscopic inclusions of extraneous matter in crystals are common enough, and often form a considerable proportion of their total bulk, and the celebrated case of Fontainebleau sandstones, where the calcite crystals contain 90 per cent. of sand, shows to what an extent this can be carried. In the case of the Charli rock, the large proportion of crystalline structure of the cement has had important results. It is a well-established fact that when a crystal is attacked by a solvent it is not uniformly acted on, but that solution acts more rapidly along certain planes which penetrate the crystal in various directions. In the case of the Charli rock this has taken place, and the numerous surfaces of contact between the crystalline calcareous cement and the grains of sand have been so many more surfaces of weakness along

which weathering could act. As a consequence the rock has become split up into a number of irregularly-shaped aggregates, and as these have the necessary interlocking projections and recesses, we again find the same peculiar kind of flexibility as in the Kaliana rock. We have excluded every other possible explanation; the Charli rock contains no mica or other flexible mineral, and the only point they have in common with each other and with other flexible sandstones is that in each case their nature is such that they have weathered into a number of granules separate from each other, and only holding together by the interlocking of their irregularities.

LETTERS TO THE EDITOR.

NOTE.—*This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.*

(8) **Light for Photographing.**—I submit the following answer to Problem No. 5: Use a short focus (5 or 6 inch) landscape photographic lens. This will produce a good general view of the object, and if the lens is a good one will show many details.
—S. G. S.

(9) **Farrant's Medium.**—I would say in answer to Problem No. 8: Farrant's medium is not worth even 3 cents per oz. if not well filtered and microscopically clean. Did F. ever try to filter the thick, gummy liquid? There is a large sized wrinkle and some tedious manipulation involved in the process, which F. does not dream about.—S. G. S.

(10) **Dry Objectives.**—I have been noticing the various letters on this subject (page 20). I think that the real point, after all, is this: when you are looking over a great number of diatoms at one sitting you can slip them in and out very quickly if you have a dry lens, and save a large amount of time. But if something requires very minute examination, the homogeneous lens is the best to use.
No SIG.

PARIS, Mar. 7, 1893.

(11) **The Van Heurck Microscope.**—No one who has ever used this instrument, especially in photomicrography, will hesitate to recommend it. Fortunately, I purchased one recently, and many of my previous difficulties in photomicrography have vanished.
GERARD SMITH.

LONDON, March 10.

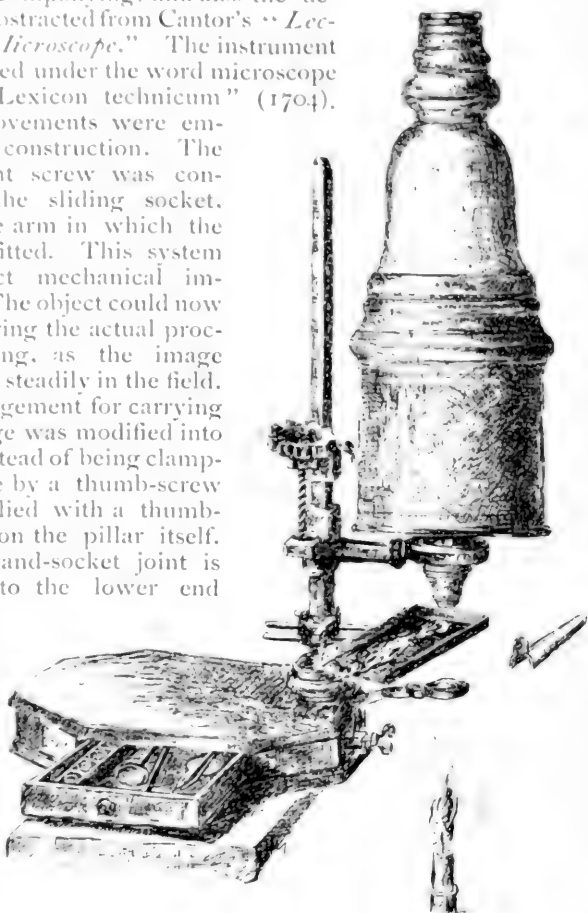
Marshall's Compound Microscope.--This curious old microscope was invented by John Marshall in the early part of the eighteenth century. It was made and sold by him at the Archimedes & Golden Spectacles in Ludgate street, London. The figure accompanying, and also the description, is abstracted from Cantor's "*Lectures on the Microscope.*" The instrument was first figured under the word microscope in Harris's "*Lexicon technicum*" (1704).

Several improvements were embodied in its construction. The fine-adjustment screw was connected with the sliding socket, supporting the arm in which the body screw fitted. This system was a distinct mechanical improvement. The object could now be viewed during the actual process of focusing, as the image would remain steadily in the field. Hooke's arrangement for carrying a rotating stage was modified into a fork, and instead of being clamped on the base by a thumb-screw it is here applied with a thumb-screw clamp on the pillar itself. Hooke's ball-and-socket joint is here shifted to the lower end of the pillar,

where it gives a movement of inclination to the whole body of the microscope instead of to the body tube only, as in previous instruments. A condensing lens

placed below the stage, on jointed arms, appears. From the singular position of the candle beneath this condenser it is probable that up to this date (1704) the mirror was still unknown as a microscopical accessory in England.

Marshall's arrangement of the fish trough with the "*Lead Coffin*," to be put on the fish to hinder it from springing away,



and moving his 'Tail out of the Light' was highly commended by Mr. Harris in his *Lexicon*. A novel feature of this instrument was the series of object lenses which appear to have been first connected with a compound microscope in this instance. The numbers on the standard were to indicate approximately the position of the coarse adjustment for the different powers. To counterbalance the instrument when in use, as figured, the opposite end of the base had a large block of lead fixed inside.

The figure of Marshall's microscope has been reproduced quite frequently in Encyclopædias and other works, and occasionally the position of the candle has been criticised as being more favorable for depositing soot on the condenser than for illuminating the object. The instrument, however, must be judged by comparison with the microscopes of its day and not with the perfected instrument of this age. Although Mr. Harris claims that Melten's and Leeuwenhoek's simple microscopes were the best in use, he also states that for price Marshall's double microscope was more satisfactory.

Elevations along the Margin of the Lens.—Topolanski (*Kl. Mon. f. Mug.*, March, 1892) describes the microscopical appearances in lenses which had previously been described ophthalmoscopically by both Magnus and himself. He concludes that the lens is not always perfectly smooth at its margin, but often shows little undulatory, or rather tent-like, elevations. The elevations are the result of the pulling action of the zonula. The capsule, capsular endothelium, and lenticular fibres all take part in their formation. They appear first as substance or tissue elevations, but subsequently change into an actual lifting of the parts involved off or away from the rest of the lens.

Microscope Mechanical Stage.—On the under side of the fixed stage is a boss with an internal thread. On the upper side are guide bars with bevelled edges on which runs another stage from right to left. On the right hand a bracket is fastened in which is fixed by a gland a screw to work in the boss. The gland fits into a nick in the spindle carrying the screw, so that when the screw is turned it draws the plate either right or left. On the top side of this plate are guide bars at right angles to those on the lower plate, on which moves a third stage. On the right hand and on the under side a rack is fixed which is moved by a pinion. This pinion turns in the aforesaid bracket and is secured by a gland, and throws the stage from front to back. A piece in the fixed stage is cut away to allow for the movement of the rack. There is sometimes a collar secured in the opening of the top stage on which another stage is placed, having a circular motion.

A Slide Carriage and Object Finder.—Mr. F. J. Boettcher of Washington has invented a carriage which is being patented and which we hope to describe in our May number.

MICROSCOPICAL MANIPULATION.

Preparing and Staining Yeast.—Dr. H. Moeller used for fixing yeast preparations a 1 per cent. solution of iodide of potassium saturated with iodine, this fluid ten times diluted, and also iodine-water. The material and the fixative may be mixed together at once or upon the cover-glass, which merely requires a smear. When fixed and dried the preparation must be thoroughly hardened. This may be done by leaving the preparations in the iodine solution for a day, and then, after washing in water and weak spirit, keeping them in absolute alcohol for one or two days. The time required for hardening may be diminished by repeatedly boiling the alcohol, and the preparations are more clearly stained if they are then immersed in chloroform for a day. It is always useful to pass the cover-glasses once or twice through the flame.

The preparations are best stained by means of hæmatein and picric acid, the latter acting as a mordant. But it is essential that the preparation should be thoroughly fixed and hardened; they may then be treated with a saturated aqueous solution of picric acid for $\frac{1}{2}$ –3 hours; the preparation is then passed through water so as to wash off some, but not all, of the picric acid. For staining, an alkaline solution of hæmatoxylin is used. It would not appear, however, that the foregoing staining was more advantageous than that with aniline, of which the following were successfully employed: phenolfuchsin, alkaline methylen-blue, Gram's method, and also gentian-violet in carbolic acid, water, glycerin, 1 per cent. acetic acid, and 1 per cent. iodide of potash.

If the aniline dyes are used the preparation should be over stained and then differentiated by some decolorant; if Gram's method be adopted alcohol must be used; but for other stains a mixture of equal volumes of glycerin and water was found to give the best results. As soon as the desired degree of decolorization is attained the preparation is washed in water, dried in the air, and mounted in balsam, styrax, or dammar.

The grana or microsomes were best brought out by staining with some aniline dye and then differentiating with 2 per cent. acetic acid.

Spores are very easily stained by treating the preparation with boiling phenolfuchsin and then washing out in 4 per cent. sulphuric acid.

The yeasts used for these observations were natural cultivations of ordinary bottom yeasts. The yeast was shaken up with distilled water and then, after settling, the fluid decanted off. The sediment, after having been thus treated several times, was kept for the observations.—*Centralbl. f. Bakteriöl. u. Parasitenk.*, xii, 1892, pp. 537–50.

Sterilization of Water by Pressure.—MM. Rouart, Geneste, and Herscher have constructed an apparatus for sterilizing

water effectually and economically by a combination of heat and pressure. As described in the *Journ. de Microgr.*, xvi. pp. 145-52, it consists of four distinct parts—a boiler, primary and secondary converter (or cooler), and a clarifier. The water to be sterilized is introduced into the primary converter—a cylindrical metal vessel surrounded by a worm in which water heated to 120° – 130° , and just coming from the boiler, is circulating. From the converter, and having been raised to 100° , the water is conducted along a pipe to a worm running around the boiler, where it is heated up to 120° – 130° . From this worm the water then passes through the worm in the primary converter, thence through the secondary converter, and finally, having passed through the clarifier, completes its circuit. The secondary converter is also a worm surrounded by cold water, and might be termed the cooler. The clarifier is filled with powdered silica, apparently between layers of canvas, and is not intended for a filter, but to impart a clearness or limpidity to the water which has been removed from it by the heating it has gone through. The water having passed through the clarifier is delivered bright and clear and fit for all the purposes of life.

To compute the magnification of an object photographed with or without an eyepiece and at different distances from the objective.—The easiest way to find this magnification is to remove the object after photographing it. Put a stage micrometer in its place, throw the image of the lines on the ground glass and compare them with an ordinary rule. This will give the correct magnification produced by that optical combination. To compute it more or less accurately, reckon that an inch objective will amplify 10 diameters at 10 inches from its optical centre. If an inch eyepiece is used multiply again by 10. Other objectives, eyepieces, and distances in proportion.

Nelson's formula is $\frac{D O}{A B}$ magnification, A = focal rating of eyepiece, B = focus of objective, O = optical tube length (from optical centres), D = distances from object to eye or ground glass. As eyepieces and objectives are rarely rated correctly, computation by any rule will give approximate results only.

Killing Nematodes for the Microtome.—Mr. C. W. Stiles, *American Naturalist* (1892) recommends the following method: Only one worm can be killed at a time; place it on a large slide with a few drops of water; place a second slide over the worm and move it slowly to and fro. This movement causes the worm to straighten. As soon as the Nematode assumes the desired position pipette in the fixing solution between the slides, continuing the motion of the upper slide until the worm is dead. By this method a specimen can be obtained which is perfectly straight and sound. Pressure on the delicate worm may be

avoided by pasting a piece of paper on the upper surface of the second slide, and using that as a handle. As a killing liquid Mr. Stiles generally uses a solution of corrosive sublimate plus 70 per cent. alcohol plus a few drops of acetic acid heated to 50°; this passes through the cuticle very rapidly.

Preserving Fluid and Fixing Material.—Dr. F. Krasser recommends as a preserving fluid for vegetable substances a mixture of 1 vol. acetic acid, 3 vols. glycerin, and 10 vols. of a 50 per cent. solution of sodium chloride. In this solution sections of beet and of etiolated potato-shoots retained their structure and their color for nearly a year.

Salicyl-aldehyde is a good fixing material for chromatophores, as e. g. the pigment of *Solanum lycopersicum*. For this purpose Dr. Krasser uses a 1 per cent. alcoholic solution.—*Jour. Royal Micr. Soc., Feb., 1893.*

To Cement Pieces of Cast-Iron.—Take 2 oz. sal ammoniac, 1 oz. sublimated sulphur, 1 lb. cast-iron filings. Mix in a mortar and keep the powder perfectly dry. When desired for use mix it with 20 times its weight of clean iron filings, grind the whole in a mortar, wet with water until it becomes a paste. Apply to the parts to be mended. It will harden after a time and cement the parts firmly.

Preparation of Larvæ of *Asterias vulgaris*.—Mr. G. W. Field found that Kleinenberg's picric salt gave the most satisfactory results for killing these larvæ. Flemming's, followed by Merkel's fluid, gave excellent results, as did also Perenyi's fluid. Oil of cedar or of origanum proved most satisfactory for clearing.—*Jour. Royal Micr. Soc., Feb., 1893.*

To Whiten Hands.—5 or 6 grains of chlorinated lime dissolved in a pint of lukewarm water will whiten the hands more than any other application.—*Med. Med. Fr., Jan. 28, '93.*

BIOLOGICAL NOTES.

Diminution of Life.—Life is believed to be a constituent of matter, not a foreign force injected into it. In the carbonaceous period a far greater quantity of matter was in the living condition than at present, say twenty times more than now.

A Marine Biological Laboratory.—It is proposed to establish a Marine Biological Laboratory at Galveston, to be under the control and supervision of the board of regents of the Texas State University, and to be in charge of and conducted by the professor of biology of the University faculty, Prof. Chas. L. Edwards, and Prof. Allen J. Smith, of the Medical Department, professor of bacteriology, pathology and microscopy. The quarantine buildings at the east end of the island, we understand, are to be appropriated for this purpose, and remodelled and

fitted up to meet the requirements. The board of regents, in their report to the governor and legislature, have recommended such a step, and in submitting their estimate for the years 1893 and 1894 asked for \$5,000 for this purpose and the equipment of the laboratory with the necessary apparatus, etc.

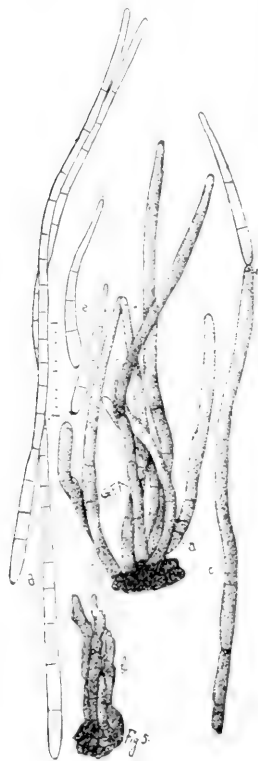
On the Fungus of Celery Blight.—Prof. G. F. Atkinson has cleared up the uncertainty which existed regarding the fungus *Cercospora apii* of Fresenius. He says in N. Y. Agr. Exp. Bull., No. 49:

Like all *Cercosporæ*, the vegetive threads of this fungus usually grow largely in the interior of the leaf, and when the nutriment at the affected spot is nearly exhausted clusters of fruiting threads arise from the vegetive ones and, issuing from a stoma of the leaf, bear elongated spores at their ends. Two clusters of the fruiting threads of *Cercospora Apii* are shown at *a* and *b*, while *c* represents a single fruiting thread with a spore still attached, and free spores are shown at *d* and *e*.

The form of the conidia is given as obclavate, *i. e.*, the base or end at the point of attachment with the hyphæ is greater in diameter than the distal extremity. The conidium *in situ* at the end of the hypha, *c*, shows this character well. The free or abjoined conidia nearly always present a well-defined scar at the larger end as shown in *d* and *e*. This scar indicates the place of attachment to the hypha, the corresponding scar on the hypha being at the end or at one of the geniculations as shown in *a* and *b*. The explanation of several scars appearing on a single hypha is that after a conidium is abjoined from the end, the hypha then grows out at one side of the scar and bears another conidium at the end, and so on. These scars at the base of the conidia enable one to determine their form even when they are not attached to their parent hyphæ.

Under normal conditions the fungus is confined to well-defined spots on the leaf with an irregular, slightly raised border. During excessively wet weather, as the leaf tissue is dying, it may spread to portions of the leaf where the spots are not so well defined. Such conditions also

induce a much longer growth of the tufts of hyphæ and their conidia; *a* and *d* represent such forms in comparison with *b* and



developed under normal conditions. The measurements including such variations are as follows: Hyphæ 50-150 x 4-5; conidia 50-280 x 4-5. The figures are all drawn to the same scale, using compensation ocular No. 6 and objective 4mm. Zeiss, with aid of camera lucida. The micrometer scale of this combination is also projected by the side of the figure.

This disease can be held in check by the use of the standard carbonate of copper and ammonia mixture applied with a knapsack sprayer.

DIATOMS.

Culture of Diatoms.—Dr. P. Miquel states that a very favorable medium for the artificial culture of fresh-water diatoms is ordinary fresh water in which have been thrown stems of grasses, the cortical substance of grains of wheat, barley, or oats, fragments of *Muscinæ*, etc.; soluble carbohydrates, albuminoids, etc., have rather an injurious effect than a favorable influence. The presence of a very small proportion—from 1 to 5 per mil.—of certain salts, such as those of soda, potash, or lime in the condition of chlorides, bromides, iodides, phosphates, and sulphates, has a marked favorable effect on the multiplication of diatoms; but they appear to prefer to obtain their silica from that set at liberty by the decomposition of plants rather than from soluble silicates. The marine kinds are easily cultivated in artificial sea-water, especially if containing fragments of *Fucus* or other sea-weeds.

In another paper on the same subject published in *Le Diatomiste*, 1892, the same author gives full instructions as to the best mode of cultivating diatoms, both fresh-water and marine, the best media for their growth, the most favorable temperature, light, etc. The most destructive enemies to the diatoms are bacteria. An apparatus is described for their culture free of bacteria.—*Jour. Royal Micr. Soc.*, Feb., 1893.

Cultivation of Diatoms.—Dr. L. Macchiati, in a preliminary communication to the *Journ. de Micrographie*, xvi, 1892, points out that diatoms are easily cultivated in the nutritive solutions used in vegetable physiology, provided that a few drops of silicate of potash be added to the medium. Or the very water which the diatoms inhabit may be used. This, when filtered, and with the addition of a few drops of strong silicate of potash solution, forms an excellent fluid. The medium, placed in a watch-glass, is then inoculated with a loopful of the water inhabited by the diatoms, and the two fluids having been thoroughly mixed together by stirring, a loopful of the mixture is placed on the surface of a cover-glass; the exact thickness is previously ascertained. To the margin of a cavity of a hollow-ground slide is then applied some vaselin, and this is carefully placed over the

cover-glass. The slide, now containing a hanging drop cultivation, is turned over.

In such a drop the diatoms are in an almost natural state, and their development and mode of life may be watched under a power as high as 118, though the lens commonly employed by the author is a dry apochromatic with focal distances of 4 mm. and N. A. 0.95. In combination with eyepieces 6, 12, 18, magnifications of 372, 750, and 1,125 were obtained.

The best part for observing the diatoms is the edge of the drop, and this should be first centered under a low power.

BACTERIOLOGY.

Preparing Nutrient Bouillon for Bacteriological Purposes.—Herren Petri and Massen in *Arbeiten aus d. Kaiserl. Gesundheitsamte*, viii, No. 2, give the following for preparing bouillon: Fresh chopped meat containing little fat is soaked for one hour in the necessary quantity of distilled water. It is next heated for three hours at about 60° C., after which it is boiled for half an hour and filtered. When cold the degree of acidity of the fluid is tested from samples of 10–20 ccm. As a rule, 10 ccm. required by the litmus reaction 1.8 ccm.; by the phenolphthalein reaction, 3 ccm. of 1-10 normal caustic soda solution. The broth obtained from the meat of different animals did not present any striking differences. After the addition of alkali pepton and soda it is boiled for some time, best over the open fire, for a quarter of an hour, and then filtered hot. Too long and too frequent boiling are to be avoided. The bouillon and the medium prepared from it are to be kept in the dark.

Degree of Alkalinity of Media for Cultivating Cholera Bacilli.—Dr. M. Dahmen has reported in the *Centralbl. f. Bakteriöl. u. Parasitenk* (1892) the results of a series of experiments to determine the most suitable degree of alkalinity for cultivation media of cholera bacilli. From them he concludes that for the examination of fæces for cholera bacilli a gelatin with 1 per cent. of soda is the most suitable, and that a faintly alkaline medium is not only not sufficient but absolutely unsuitable.

Staining Flagella of Bacteria.—Herr L. Luksch finds that by substituting ferric acetate for the sulphate of iron in the mordant devised by Loeffler for staining bacterial flagella the disagreeable deposit of the surface of the preparation is obviated. It is certainly true that this deposit renders the original procedure less effective in practice than the promise held out, and it is noted by the author that Loeffler's solution should be made with ferric and not with the ferrous salt, but if the acetate gets rid of the surface deposit the distinction may be neglected.

The author's solution is made from freshly prepared cold sat-

urated ferric acetate; in other respects the formula is the same as Loeffler's, except that to the 16 ccm. of the mordant 5-10 drops of acetic acid are added.

When the preparation has been slightly warmed for one minute it is washed in water and then in 20 per cent. acetic acid to give greater clearness. It is again washed in water several times, after which it is warm-stained with anilin-water-fuchsin or anilin-water-gentian-violet.—*Four. Royal Micr. Soc., Feb., 1897.*

MEDICAL MICROSCOPY.

Method for Differentiating between Bacilli of Typhoid Fever and Water Bacteria closely resembling them.—Dr. J. Weyland examined some drinking water suspected of giving rise to enteric fever, and isolated therefrom a species of bacterium the morphological and cultivation characteristics of which were not to be certainly distinguished from those of true typhoid bacilli. The negative indol reaction served to increase the suspicion of their identity.

The author first set about comparing the vitality of these bacilli with those of real typhoids, but no notable differences were shown, and recourse was had to chemistry. As the bouillon cultivation of both kinds had an acid reaction, the amount formed in 10 ccm. of milk serum was first ascertained. For this Petruschsky's method was adopted, but phenolphthalein was substituted for litmus as indicator. After having been incubated for three days, it was found that the serum inoculated with the real typhoid required 8-9.1 ccm. of 1-100 alkali solution to neutralize it, while the pseudo-typhoid took 12.9-15.4 ccm. The amount of carbonic acid formed by the two kinds of bacteria was then determined by Pettenkofer's method; this consists in forcing the carbonic acid formed by the bacteria into tubes filled with baryta water, and estimating the diminution of alkalinity by titration with oxalic acid.

The only caution to be observed is that the fermentation bulbs must be kept at similar temperatures, as the slightest difference in heat has an important influence on the production of carbonic acid. This part of the experiment lasted ten days, and the result of it was that the pseudo-typhoid bacilli were found to have produced about five times as much carbonic acid as the true typhoid bacilli. A repetition of the experiment gave a similar result. It was accordingly determined that the water bacteria in question were not typhoid bacilli.—*Archiv f. Hygiene, xiv, p. 374.*

Examining Sputum in Sections.—When examining sputum in cover-glass preparations many of the delicate and fragile cells, says Dr. Gabritschewsky in *Deutsh. Med. Wochenschr., No. 43,*

are destroyed, but this may be avoided by making sections of sputum which has been fixed and hardened. For this purpose alcohol, Flemming's fluid, chromacetic acid, picric acid, and saturated sublimate solution are well suited. Müller's fluid cannot be used, as it softens and disintegrates the masses of expectorant.

The staining solutions employed by the author were aluminocarmine, safranin, and hæmatoxylin-eosin. By this method, in three cases out of four examined, giant cells were demonstrated.

Tubercle Bacilli Detection.—Dr. Solles suggests the following method for searching for tubercle bacilli in tissue. Small cubes of the tissue are colored with the two following liquids:

1. Distilled water, 100 parts; Prussian blue, 1 part; oxalic acid, 2 parts.
2. Distilled water, 100 parts; gelatin, 1 part.

The two liquids are mixed and the bits of tissue immersed for a sufficient time. They are then put for 12 hours in absolute alcohol, 12 hours in ether, and the same time in celloidin. By this method the anatomical elements are all colored, while the microbes remain uncolored. He has studied microbes in cancer by the same method.

MICROSCOPICAL NOTES.

New List of Microscopic Sections of Rock and Minerals.—New and interesting specimens from Colorado, Australia, New Zealand, Brazil, Hungary, Scotland, Wales, etc., 1-6 each. special sets for physiography. List free. James R. Gregory, 88 Charlotte St., Fitzroy Sq., W. London.

Rock Sections for the Microscope.—From 1-6 each: collections of minerals for cabinets etc. Thomas D. Russell, 78 Newgate St., London, E. C.

Living Specimens for the Microscope.—*Volvox globator*, *Epistylis flavicans*, *Spongilla fluviatilis*; ova of trout, showing circulation of blood; *Amœba*, *Vorticella*, *Hydra*, etc., specimen tube with drawing and description, 1 s., post free. T. E. Bolton, Farley Road, Malvern Link.

MICROSCOPICAL SOCIETIES.

BIOLOGICAL AND MICROSCOPICAL SECTION, PHILADELPHIA ACADEMY OF SCIENCES.

This section held, during the year 1892, nine meetings, exclusive of those in conjunction with the Academy. The membership has been increased by one new member, and one name has been added to the list of contributors. Many interesting communications have been made, the more important of which are: On *Actinomyces bovis*, by Dr. S. G. Dixon; A Peculiarity in

the Skull of a Bat, by Dr. Harrison Allen; Young of Baculites, by Mr. A. P. Brown; Syphoptychium and Tubulina, by Dr. G. A. Rex; Films of Metallic Gold, by D. S. Holman; Hippa, by Dr. Benjamin Sharp; Pinnotheres, by Dr. Benjamin Sharp; Joint Formation among the Invertebrata, retiring address of Director Benjamin Sharp.

Additions to the property of the section have been made as follows: By purchase—one Spencer $\frac{1}{4}$ inch objective; two "B" eyepieces; by donation—one 1-10 inch objective; from Mr. A. P. Brown; one Centennial microscope from the heirs of Dr. R. S. Kenderdine; about 600 slide preparations from the heirs of Dr. R. S. Kenderdine; about 45 slide preparations from Mr. Harold Wingate; about 50 slide preparations from Dr. George A. Rex; about 25 slide preparations from other members.

The officers for the ensuing year are: Director, Mr. A. P. Brown; Vice-Director, Mr. Jno. C. Wilson; Recorder, Mr. Harold Wingate; Treasurer, Mr. Chas. P. Perot; Corresponding Secretary, Dr. Chas. Schaeffer; Conservator, Dr. Geo. A. Rex.

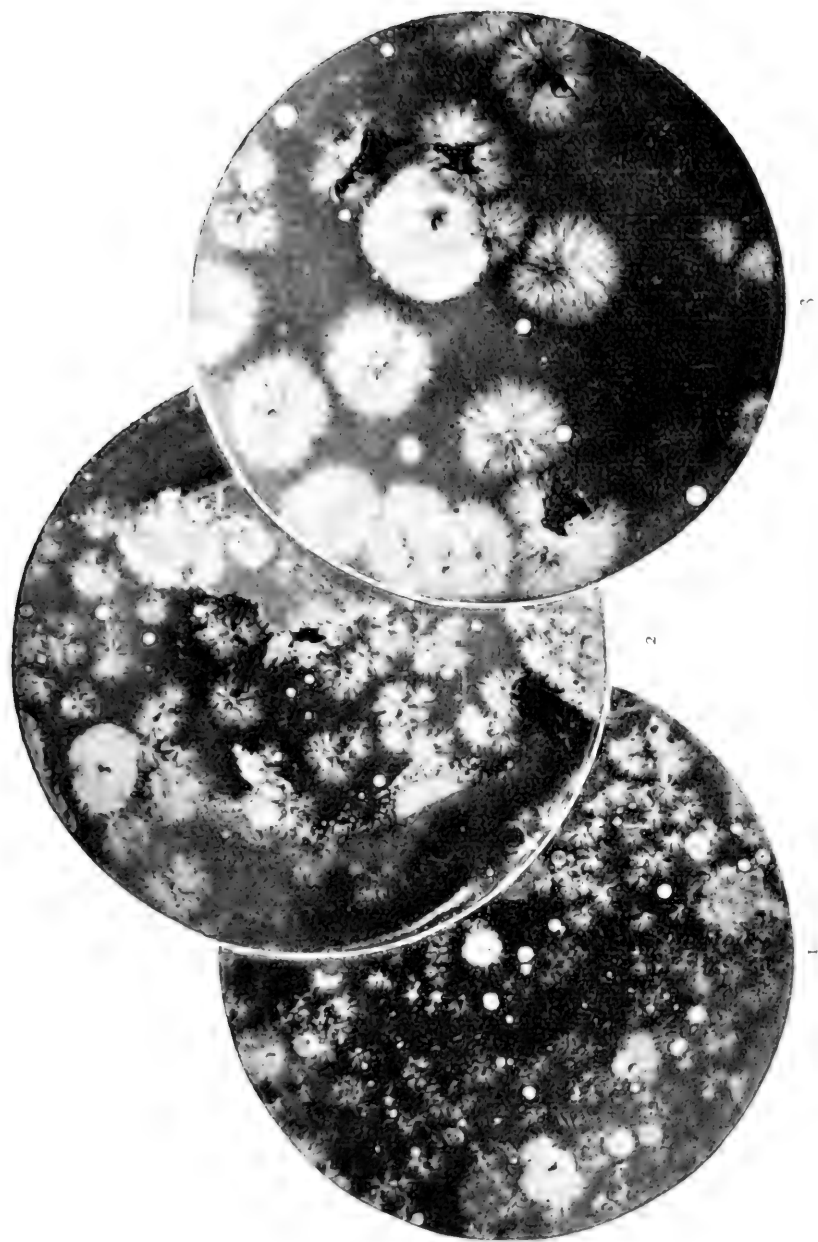
QUEKETT MICROSCOPICAL CLUB, LONDON.

309th ordinary meeting, Feb. 17.—20 Hanover street, Dr. W. H. Dallinger in the chair. Ballot was taken for president and officers for the ensuing year.

The secretary read the 27th report of the committee, and the treasurer his annual statement. Officers were elected as follows: For President, Mr. E. M. Nelson; for Vice-Presidents, Dr. Dallinger, Prof. Lowne, Mr. Michael, Prof. Stewart; for Foreign Secretary, Mr. C. Rousselet; to fill five vacancies on the committee, Messrs. Newton, Parsons, Western, Hembry, and E. Browne.

The president then gave the annual address. Dr. Dallinger first dealt with the optics of the modern objective, and pointed out that under the present conditions it had reached the limits of practical utility, or even exceeded them. He referred to monochromatic illumination, and expressed a hope that English makers would endeavor to work out objectives for use with light of certain wave lengths. He next gave an account of Prof. Bütschli's "foams," or so-called artificial protoplasm, and his own experiments with it, and pointed out that, however important and interesting from a physical basis, it possessed none of the distinctive characters of true living matter. Finally he gave a résumé of Pasteur's and Frankland's researches on nitrification as caused by micro-organisms.

Dr. Dallinger vacated the chair, installing Mr. Nelson, the newly elected president, who expressed his thanks for the honor conferred upon him, and presented to the club a handsome cabinet containing a collection of over 1,100 specimens, mostly selected Foraminifera, made by the late Mr. Hailes, as a memorial of their editor and foreign secretary.



A FUNGUS STUDY-PLATE CULTURE, SHOWING SEPARATION OF ANTHRACNOSE

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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No. 5.

A Study of a New Fungus.

By GEO. F. ATKINSON,

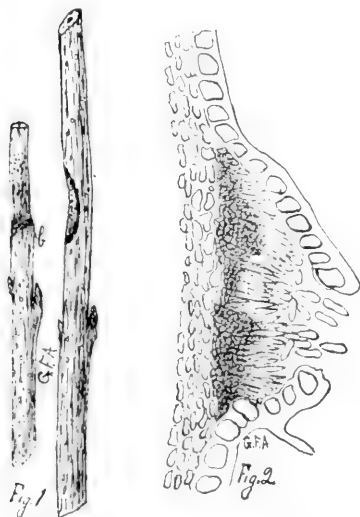
ITHACA, N. Y.

[WITH FRONTISPIECE.]

[The girdling anthracnose, *Glaeosporium cingulatum*, is a new species of fungus which has recently been described by Prof. Geo. F. Atkinson in Bulletin No. 49 of the Cornell University Agricultural Experiment Station. It was found parasitic upon the privet (*Ligustrum vulgare*), at Penn Yan, N. Y., and is quite similar to the "ripe rot" of apples (*G. fructigenum*.) We extract the following paragraphs from his report, which shows some excellent microscopical work, and we acknowledge the kindness of the Station officers in loaning us the cuts.—ED.]

Appearance of the Diseased Twigs.—From 12 to 18 inches or more of the terminal portion of some of the twigs was

dead, the point where the dead portion joined the healthy presenting the depressed line observable on twigs of pear and apple affected with the blight. The resemblance to blight, however, was only superficial and confined to twigs in the final stage of the disease. Other twigs presenting an apparently healthy terminal portion were found to be diseased at a point about 12 to 18 inches from the end, where a depressed area of diseased tissue was observed, oblong in outline, the longer diameter being parallel with the longitudinal axis of the stem. A comparison of the different specimens showed that this diseased area, quite small primarily, and seated only upon one side of the twig, gradually increased in size



DISEASED TWIGS. SECTION OF A PUSTULE.

until eventually it extended entirely around the twig, completely

girdling it. The supply of nutriment thus being cut off from the terminal portion of the twig, death of that portion followed.

Seated in the original diseased areas, whether extending partly or entirely around the stem, are minute black elevated points which can be seen with the unaided eye. Figure 1 *a* and *b* represent portions of twigs, *a* with the diseased area extending partly around the stem, while *b* is girdled. In the diseased areas are shown these small black elevations. The disease is produced by a fungus which grows within the stem. These black elevated points are centres where pustules of the fungus are developed containing its reproductive bodies, or spores.

Section Across one of the Pustules of the Fungus.—Figure 2 represents a very thin section across one of these pustules, magnified to show the structure of the pustule and the form of the spores. The growth of the pustule has ruptured the epidermis of the stem. In the opening between the broken parts of the epidermis are shown some of the spores. Beneath these are numerous parallel short fruiting threads, or basidia of the fungus, at the end of which the spores are developed. The basidia can be seen to arise from the blackened stroma of the fungus, which consists of quite a compact association of irregular cells. The black color of the pustules comes from the stroma.

Method of Separation of the Fungus.—To study the development of the fungus it was necessary to separate it from other common forms of fungi as well as bacteria which always find a lodgment in and upon dead plant tissue. Since all these forms are microscopic the separation involves a method of procedure familiar only to specialists, and as such beautiful results were reached in the separation of this fungus it suggested a graphic presentation of the method in connection with the study. The method used was the same as that which Koch developed so admirably for the separation of bacteria, and consists in the dilution of the organisms in several quantities of a warm liquid substance which, when spread out in a thin layer and cooled, solidifies and holds each germ firmly fixed at one point in the dilution. This substance is usually some gelatinous base, as gelatin, or agar-agar, containing beef broth and peptone to furnish food for the organisms. In a few days after cooling the dilutions in the thin layer each germ by growth has produced a colony which can be seen with the unaided eye.

Three glass tubes containing a small quantity of liquid nutrient agar-agar were placed in the water bath at 43° centigrade. This temperature is sufficient to keep the agar liquid, while it is not hot enough to kill the organisms. Now several thin shavings through the fungus pustules on the stem of the privet were transferred to tube No. 1. This was shaken gently to distribute the germs evenly through the liquid. Now a small quantity of the liquid in No. 1 containing the germs was transferred to tube No. 2, making the second dilution, and from No. 2 to No 3, making

the third dilution. Experience enables one to judge quite accurately in making the dilutions so that we estimate the dilution sufficient to cause each germ to lie separately at different points in the liquid agar, at least in dilution No. 3.

Each of these dilutions was then poured into a petrie dish,* and allowed to cool in a thin layer over the bottom. No germs could then be seen in the agar, since they are microscopic and lie singly. The dishes were piled away for a few days. During this time each germ grew and produced a colony which was visible to the unaided eye. The plates or dish cultures were now photographed natural size and the result is produced in the frontispiece. In No. 3 it will be seen that nearly all of the colonies are separate. The snowflake-like colonies are those of the desired fungus. The small, compact, circular ones are those of bacteria. One large compact colony is that of a common fungus.

In Nos. 2 and 1 the fungus colonies are crowded, and have not made such good growth. The colonies of bacteria are more numerous also, and it would be very difficult to obtain a pure culture of the fungus in either of those dilutions. If the dilutions were not numbered it would be an easy thing to determine their number from the size and number of the colonies. The very large compact colony in No. 2 is that of a motile bacterium.

Pure Cultures of the Anthracnose.—Pure cultures of the fungus could now be started by transplanting with a flamed platinum needle portions of the fungus colonies from No. 3 into a culture-tube of nutrient agar. The photograph was taken after these transplantings were made, which accounts for the broken appearance of some of the colonies.

From the point of inoculation in the culture-tube, where the transplanting was made, the fungus threads grow out through the upper surface of the agar, radiating in all directions. In a few days minute black bodies appear seated here and there upon the mycelium. These resemble the stroma at the base of the pustules on the stem, but in the artificial cultures do not seem to be especially concerned in the production of basidia and spores, since but a few are developed in connection with them.

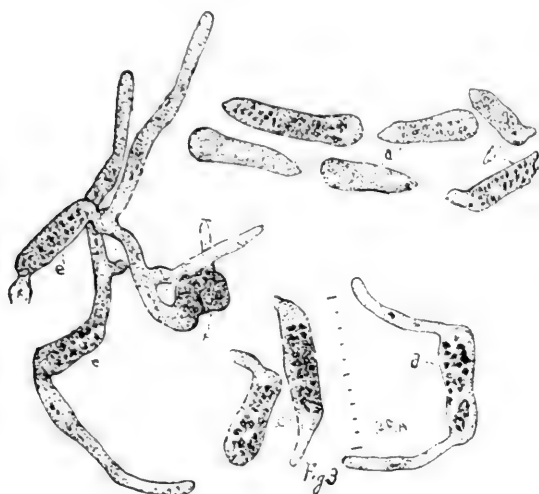
Numerous basidia and spores are produced, however, all along the threads, and a mass of them at the point of inoculation. In a few days more many fungus threads arise above the agar and produce a fluffly white growth upon the surface, nearly obscuring the black points.

No pigment was noticeable in these cultures. New cultures were then started by transplanting portions of agar the size of a small pea with a mat of mycelium and spores to fresh culture-tubes. In the fresh agar the growth took place in the same manner as in the first tubes, but upon the surface of the transplanted portions a faint pink pigment appeared.

* A petrie dish is composed of two shallow glass vessels, one about three inches in diameter, which serves as the bottom; the other of a little greater diameter, which is inverted over the first one for a cover.

Cell cultures were made in order to observe with the microscope the different phases in germination of the spores and growth of the fungus. Liquid agar containing a dilution of spores from one of the culture-tubes was poured upon a sterilized cover-glass, which was then inverted on the ring of the cell. Figure 3, *a*, represents some of the spores in the cell culture. They are oblong, usually pointed at one end, nearly cylindrical, and either straight or slightly curved. The appearance of the contents of the spores varies. Sometimes the protoplasm is nearly homogeneous, with one or more vacuoles, or it may be finely granular, with no

vacuoles or quite coarse granules may be irregularly distributed in the homogeneous protoplasm. The latter condition is a very common one before germination, and the behavior of these granules has suggested that possibly they may be stored products to be used during the process of germination and the early growth of the mycelium. It does not seem there could be



GERMINATION AND GROWTH OF MYCELIUM.

any need of such stored products for spores in artificial cultures where the spore lies in a rich nutrient media. But they might serve the spores a good purpose in natural conditions where the spore lies upon the surface of the plant and must often produce considerable growth of mycelium before the thread reaches nutritive tissues.

In germination one or more germ tubes arise from the spore, usually at one side of the ends. Figure 3, *b* and *c* represent different stages in germination. The coarse granules are quite numerous, and in *d* some of them have moved out into the forming mycelium. Figure 3, *e* represents a farther development of mycelium, and also a farther distribution of the granules in the threads.

Figure 4, *a*, *b*, and *c* are three camera-lucida sketches of the growth from a spore which was sown December 14th, at 12.35 P. M. *a* represents the growth which had taken place in exactly 24 hours, being sketched at 12.35 P. M., Dec. 15th. *b* was

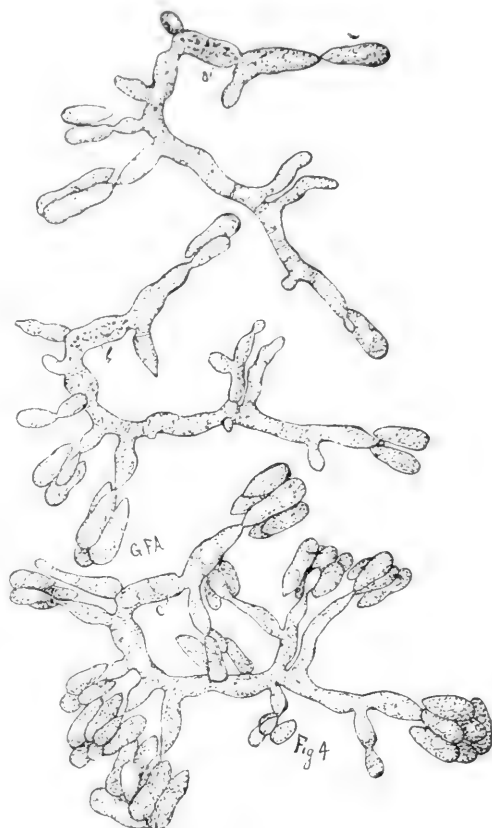
sketched from the same object at 3.15 P. M. on the same day, and *c* at 11.45 A. M., Dec. 16th. The spores are therefore developed with great rapidity under favorable circumstances. In the same culture were other spores which developed a much greater extent of mycelium and number of spores. This group was chosen because of its limited extent, being thus more convenient to sketch.

During the growth and production of spores the coarse granules gradually disappear. As the culture ages the mass of spores becomes greater at the centre of each group of mycelium. In a few days spore production seems to cease and then long sterile mycelial threads grow out to a considerable distance.

At the same time there are usually developed buds or gemmæ, at the ends of certain threads. These are colorless at first and may be detected by their irregularly oval outline, and greater diameter than the parent thread. They soon acquire a dark brown color,

sometimes become septate, or bud into rudimentary sclerotia. One of these developed quite early in the culture is shown at *x*, figure 3.

Spores were also sown on sterilized bean stems. The fungus grew readily and produced numerous spores during a few days, when the threads assumed a dark brown color and grew in great profusion over the surface of the stems. Frequently the threads associated themselves into strands, or compact wefts of parallel threads several layers deep. Within these wefts and strands were developed numerous bodies suggesting pycnidia, or perithecia,



STAGES OF GROWTH FROM A SPORE.

rotund in form, the interior cells hyaline and with rich protoplasmic contents, the peripheral cells dark brown in color.

In some cases these measured 80 to 100 μ , and frequently the depth of the web of dark mycelium in which they were seated exceeded this measurement.

Late upon the surface of this growth free threads arose in a procumbent, assurgent, or nearly erect position. All of this development on the bean stems took place in ten days. The blackening of the stroma in the pustule on the stems of the privet is probably analagous to the dark web of mycelium developed over the bean stems in the culture.

BOTANICAL DEPT., CORNELL UNIVERSITY.

A Pneumatic Bubble Remover.

By A. P. WEAVER,

JACKSON, MISS.

Being annoyed with air bubbles in my mounts, I have made a simple air-pump for removing them, as follows: Take a small rubber syringe, the packing on the cylinder of which ought to be adjustable so as to fit the body of the syringe rather tightly; cut off the nozzle rather close to the body, and bore a hole 3 mm. in diameter near the top of the latter, so that the packing will always be below the hole. Cut from an old rubber boot two washers 2.5 cm. in diameter and with a central aperture of 2 cm.; cement these washers together with Red Cross cement (such as is used for mending punctures in pneumatic bicycle tires); cut from the boot two more washers of the same outside diameter and with a central hole a little smaller than the nozzle of the syringe; cement these last two washers together also, and cement them to the first two prepared; you will now have a shallow chamber a little larger than the cover-glass. Force the nozzle of the syringe through the opening in the two top plates and firmly cement it there. All these joints must be air-tight.

To use the instrument, place the slide on a smooth surface, wet the under surface of the rubber washers and apply the same to the slide with the cover-glass in the shallow chamber. To make a good air-tight contact with the slide, grasp the syringe with the left hand and allow the lower side of the latter to hold the washers firmly to the slide. The hole drilled in the syringe is to act as a trap or valve and is to be tightly covered with the first finger of the left hand (keeping the latter in position, grasping the syringe and holding the washers to the slide) at each downward stroke of the piston and uncovered at each upward stroke. This is, of course, done to prevent the entrance of air to the vacuum chamber beneath, after it has once been exhausted. I have found that three or four strokes are sufficient to bring all bubbles to the surface of the mounting fluid and cause them to burst.

On Some Recent Advances in Water Analysis and the Use of the Microscope for the Detection of Sewage Contamination.

By GEO. W. RAFTER,

ROCHESTER, N. Y.

[*Read before the Buffalo, N. Y., Microscopical Club, Dec. 12, 1892.*]

It is quite within the memory of nearly every member of the Buffalo Microscopical Club to recall the time when chemical analysis alone was the only available method for determining the sanitary value of a drinking water. Then came the development of methods of bacteria culture, accompanied by a clearer appreciation of the necessity, before deciding as to the wholesomeness or unwholesomeness of a given water, of a thorough study of the environment, or, in other words, of a study of the various pollutions affecting the sources from which a supply is drawn; and finally the latest, and possibly quite as important as any, the development of a method whereby the minute life other than the bacteria can be quantitatively enumerated with an accuracy which, while not absolute, is still sufficiently so for the practical purpose of study of sanitary significance and comparison.

It is unnecessary to occupy time on this occasion either in describing just how the quantitative enumeration of the microscopical forms in potable water is actually accomplished, or in pointing out the part taken by the author in the final working of what is known as the Sedgwick-Rafter method of making the microscopical enumeration. It is sufficient to simply refer those interested to the original paper with detail in the proceedings of the Rochester Academy of Science.* The method there described was also exhibited at the working session of the Buffalo meeting of the American Microscopical Society and is referred to in the proceedings for that year (1889).

There are, however, a few points of historical interest which may be casually referred to here, namely, in relation to the work of the Microscopical Section of the Rochester Academy of Science, and the essential assistance received from a number of friends in that body, without which it is probable the methods of microscopical study of the minute life would have been somewhat less perfect than they are at the present time. The points thus deserving record are briefly as follows:

* Biological Examination of Potable Water. Proc. Roch. Acad. Sci., vol. 1, pp. 34-44.

The method is also described in Part II of the Special Report of the Massachusetts State Board of Health (1890), on Water Supplies and Purification of Sewage, etc., at pp. 808-811, where may also be found an account of Professor William T. Sedgwick's Sand Method, etc.

The method may also be found described in the author's *The Microscopical Examination of Potable Water*. D. Van Nostrand Co., 1892.

Also see *The Microscopical Examination of Water*, by Gary N. Calkins, Assistant Biologist, in 23d Annual Report Massachusetts State Board of Health (1891), pp. 327-421. In this paper the Sedgwick-Rafter method is fully described, certain improvements suggested, and possible sources of error pointed out; it may be referred to as the latest and most complete exposition of the detail of the method of microscopical enumeration.

About seven years ago the author became satisfied that the microscope was capable of yielding a large amount of useful information in regard to the natural history of water supplies, and, in pursuance of this view, began a somewhat extensive study of the biology of the water supply of the city of Rochester. At that time, aside from some work done by Mr. Vorce at Cleveland, and by Prof. Kellicut and Mr. Mills at Buffalo, almost nothing had been done in the way of systematic study of all the forms present in public water supplies.* The observations of these gentlemen may be found recorded in the proceedings of the American Microscopical Society, and it is therefore unnecessary to further refer to them at this time, except to say that some of their generalizations as to (1) the permanency of certain forms at all seasons of the year, and (2) as to the actual quantity of microscopical life in Lake Erie water, are of interest and value, and have largely furnished the incentive for more extended observations on the part of the author.

A few months' study was sufficient to show that the task undertaken was a very large one, and accordingly, in May, 1886, the author presented a paper to the Microscopical Section of the Rochester Academy of Science, in which it was suggested that the Section take up the systematic study of the Hemlock Lake water supply of the city.† This was followed by a second paper in December of the same year,‡ with the result that finally the Section undertook the proposed study, continuing without interruption for nearly three years. To Major William Streeter, Drs. M. L. Mallory and J. Edw. Line, Mr. A. L. Dumond, and other members of the Microscopical Section of the Rochester Academy of Science, the success of the work was very largely due; and while the present writer, by reason of mostly being the author of the various papers put forth, has received the greater portion of whatever credit attaches to the work, it is nevertheless just that the gentlemen in question should receive recognition as joint participants with the author in what has apparently turned out to be on the whole an exceedingly useful study in new fields. In making this special acknowledgment, the author further takes occasion to say that he hopes any other person beginning similar studies may be blessed by the counsel of such tried friends as those whose services are here gratefully acknowledged.

The work included (1) weekly examination of samples of

* The writer does not overlook the early work of Prof. John Torrey on the Croton, or Prof. Horsford and others at Boston, or the more recent work at Boston of Professors Farlow, Remsen, Hyatt, Mr. Burgess, Mr. Fishy and others, and of Prof. Lattimore at Rochester, etc. These, however, were all comparatively short studies undertaken for a special purpose and soon discontinued. The work of Messrs. Vorce, Kellicut, and Mills, therefore, stood almost alone as systematic attempts to determine by microscopical methods the sanitary significance of the vast number of minute forms found in even very pure waters, and, as such, deserves special attention in a historical notice of this kind.

† On the Use of the Microscope in Determining the Sanitary Value of Potable Water, with Special Reference to a Study of the Biology of the Water of Hemlock Lake. *Proc. Micr. Sec. Roch. Acad. Sci.*, 1886. By Geo. W. Rafters.

‡ How to Study the Biology of a Water Supply. *Proc. Micr. Sec. Roch. Acad. Sci.*, 1887. By Geo. W. Rafters.

water drawn from the mains in different part of the city, (2) frequent examinations of the water of the two reservoirs of the Rochester system, and (3) a study of samples taken from different parts of Hemlock lake as well as from the influent streams and various parts of the tributary drainage area of the same.* Incidentally, for purposes of comparison, studies were also made of many of the streams and other bodies of water in the vicinity of Rochester, as, for instance, the Genesee river, Lake Ontario, Irondequoit bay, etc.

The complete details of these various studies are too extensive to be given at length, and we may merely refer to some of the results at Hemlock lake, where plant forms have been identified as follows :

Chlorophyceæ, 20; Cyanophyceæ, 15; Desmidiæ, 14, and Diatomaceæ, 41, making a total of plant forms of 90. The maximum quantities of some of these minute plants per 100 cubic centimetres are, *Protococcus*, 2,000; *Anabaena*, 20,000; *Cælosphærium*, 34,000; *Asterionella*, 40,000; *Cyclotella*, 60,000; *Fragillaria*, 25,000; *Stephanodiscus*, 60,000. The total number of animal forms is 92, of which 3 are classed as Spongidiæ; 10 as Rhizopoda; 29 as Infusoria; 2 as Hydroida; 14 as Rotifera; 3 as Polyzoa; 21 as Entomostraca; 1 as Malacostraca, and 10 as insect larvæ. As to maximum quantities of animal forms observed, we find among infusoria, *Dinobryon*, 12,000; *Glenodinium*, 25,000, and *Vorticella*, 9,600.

The quantities of minute life present in Hemlock lake, while apparently large, are in reality quite small, as will be readily appreciated by reference to a statement of the number present in Ludlow reservoir, Springfield, Massachusetts, where the following maximum quantities per 100 cubic centimetres have been observed; Of the diatoms, *Asterionella* and *Melosira*, 405,600 in April, 1890; *Cælosphærium*, 157,600 in August, 1889; *Chlorococcus*, 322,400 in October, 1889; of animal forms the infusorian *Dinobryon* showed 364,400 per 100 cubic centimetres in February, 1890.† But even the large quantities of minute life found at Springfield are dwarfed into comparative insignificance by the results of a series of examinations of the water supply of Newport, R. I., as given by Dr. Drown in a recent report, from which it appears that on August 31, 1891, there were present in Easton's pond, one of the sources of supply for Newport, the large number of grass-green alge (Chlorophyceæ) of 677,750 per 100 cubic centi-

* Some of the results of these studies may be found in :

1. On the Micro-Organisms in Hemlock Lake Water. Proc. Micr. Sec. Roch. Acad. Sci. 1888. By Geo. W. Rafter.

2. On *Volvox globator* as the Cause of the Fishy Taste and Odor of the Hemlock Lake Water in 1888. An. Rept. Ex. Bd. of the City of Rochester for the year end. April 1, 1889. A Rept. by M. L. Mallory, Geo. W. Rafter, and J. Edw. Line.

3. Report on an Epidemic of Typhoid Fever at the Village of Springwater, N. Y., in Oct. and Nov., 1889. In An. Rept. of Ex. Bd. of the City of Roch. for yr. end. Apr. 1, 1890. By Geo. W. Rafter and M. L. Mallory.

4. On the Fresh-Water Alge and their Relation to the Purity of Public Water Supplies. Proc. Am. Soc. C. E., Dec., 1889. By Geo. W. Rafter.

† Derived from tabulations in the 22d An. Rept. of the Mass. St. Bd. Health.

metres; on September 11, 1891, there were found 927,400; on October 8 the number had fallen to 675,700, but subsequently again rose until the enormous maximum was attained on January 18, 1892, of 1,428,600 per 100 cubic centimetres. Diatoms were present on the same date to the amount of 200,700 per 100 cubic centimetres, giving a total of diatoms and grass-green algæ of 1,629,300.

On August 31st this water contained bacteria to the amount of 23,300 per 100 cubic centimetres; September 11, 49,100; and on October 8, 708,000 per 100 cubic centimetres.

Of the blue-green algæ (Cyanophyceæ) there were present on August 31, 271,000 per 100 cubic centimetres; on September 11, 266,800 blue-green algæ; on October 8, 8,400 blue-green algæ, while on January 18, 1892, blue-green algæ were entirely absent.

This series of analyses of samples from Easton's pond brings out the importance of a knowledge of the microscopical forms, in order to appreciate the significance of the bacteria. Thus on August 31 and September 11 there were only 23,300 and 49,100 bacteria per 100 cubic centimetres, while the sum of the grass-green and the blue-green algæ on the same dates is 548,750 and 1,194,200 respectively. On October 8 blue-green algæ had fallen to 8,400, while bacteria had risen to 708,000 per 100 cubic centimetres.

Dr. Drown's report gives a series of analyses of samples from South pond and Paradise pond, also sources of supply for the city of Newport, which further illustrate the same points.

While the foregoing, however, may be deemed sufficient for present purposes, it may be still remarked that this Newport report, by reason of presenting (1) a detailed study of the environment; (2) the physical properties of the water; (3) the chemical constituents, and (4) a quantitative enumeration of the living forms, including the bacteria, may be considered a complete sanitary analysis, the first, so far as the author is aware, that has been published of any city water supply aside from those made under the auspices of the State Board of Health in Massachusetts. The Massachusetts reports thus far have not presented the number of bacteria; hence the Newport report in reality marks, in a very satisfactory way, a new era in the sanitary analysis of potable water. The Board of Health of Newport, in causing such a study of the water supply of the city to be made, has set an example of intelligent appreciation of the recent advances in this department, which, it is hoped, will bear fruit, not only in increased healthfulness to the citizens of Newport, but in increased incentive to similar work in other towns.*

The water supply of the city of Boston may be mentioned, in this connection, as one where the microscopical life has been

* For detail of the Newport water supply see a report to the Board of Health of the city of Newport, R. I., on the character of the public water supply. By Thomas M. Drown, M. D., Prof. of Analytical Chemistry in the Mass. Inst. Tech., 1892.

studied in considerable detail. The following statement of organisms in Lake Cochituate, one of the sources of supply to that city, is based upon weekly observations for two years, and gives a list of the predominant organisms with the number per 100 cubic centimetres sometimes reached or which may be commonly looked for :*

Asterionella	200,000	Anabaena (sterile)	15,000
Tabellaria	100,000	Cyclotella	10,000
Melosira	75,000	Microcystis	5,000
Protococcus	30,000	Monas	5,000
Synedra	25,000	Celosphaerium	2,500
Crenothrix	20,000	Clothrocystis	2,500

In the foregoing is set forth some of the results attained by use of the new method of quantitative enumeration of the microscopical forms present in potable water. Let us now briefly examine another phase of the question.

At the present time the development of new and more exact methods of water analysis has produced, in matters relating to the conservation of public water supplies, what may be termed a transition state, in which the progressive movement is, as we have already seen, clearly in the direction of a study from every possible point of view, rather than from one or two, as has been until recently almost universally the case ; this change is so marked that a review of some phases of the advance in methods of studying the sanitary value of potable water may be profitably made.

It is to England that we are chiefly indebted for the most of our early knowledge of the sanitary properties of water. The large amount of work in the way of study of the pollution of streams by sewage and manufacturing which has been accomplished there within the last fifty years has easily placed England first in the list for improvements in this branch of sanitary knowledge. In proof of this we have only to consider (1) that, until within the last decade, chemical analysis has furnished the only scientific method of assisting judgment in the selection of the source of a public water supply ; and (2) that of the three methods of chemical analysis which have been generally used, two, at any rate, are purely English developments, while the third, though originating elsewhere, has perhaps received its most extensive application in the hands of an eminent English chemist. The three systems of chemical analysis which are here referred to are the "albuminoid ammonia process" of Wanklyn, Chapman & Smith, the "combustion process" of Franklin & Armstrong, and the "permanganate process" of Forchhammer, which in England has been adopted and extensively used by Dr. Tidy. All of them have been developed and reduced to practical value within the last twenty-five to thirty years. Previous to that time, about all attempted in water analysis was the determination

* Sixteenth An. Rept. of the Boston Water Board for the 13 months ending Jan 31, 1892, p. 66.

of the total solids and the total organic matter, this latter determination being absolutely without reference to the question of quality. The recent examination of a large number of published analyses has forcibly impressed upon the writer the almost entire lack of appreciation of a necessity for information as to what may be termed the detail of the organic constituents which prevailed as recently as thirty to forty years ago.

A few far-seeing students had, indeed, perceived clearly that the current analyses of the day were considerably short of revealing the thing necessary to be known, namely, what may be termed the natural history of potable water. Chief among such must be mentioned Dr. Hassall, whose illustrated memoir on the water supply of London was published in 1850. This, however, was too far in advance of the day of its publication, and stood alone for twenty years as the first guide-post on a new road to a more exact knowledge of the detail of the natural history of potable water.

In the meantime a number of eminent chemists had clearly perceived the necessity for additional information in regard to the condition of the contaminating organic material more or less present in all waters, and various refinements in chemical methods of study were accordingly made: for instance, the distinction between the free and the albuminoid ammonia of the Wanklyn, Chapman and Smith process; the distinction between the organic carbon and the organic nitrogen of Frankland's combustion process, etc. Without going too much into the detail, let us consider some peculiarities of the combustion process which are of historical value in the present connection and at the present time.

Probably, among the working water analysts of two decades ago, Dr. Frankland perceived, more clearly than any other, the necessity for distinguishing between the contamination resulting from the waste products of animals, etc., and that produced either by purely vegetable growth in water itself, or by surface water coming in contact with vegetable matter in its ordinary course or flow; hence we find as distinctive features of the combustion process the determination of the organic carbon, the organic nitrogen, and the estimation of the previous sewage or animal contamination, a knowledge of these three together with that of the free ammonia, nitrites, nitrates, and chlorine constituting in Dr. Frankland's view a nearly complete natural history of water.

With regard to the organic carbon and the organic nitrogen, Dr. Frankland remarks in the Sixth Report of the Rivers Pollution Commission (1874) that the animal or vegetable origin of the organic matter contained in potable water may, in most cases, be judged by the relative proportions in which the two elements, carbon and nitrogen, occur in the organic matter, and that in waters contaminated by organic matter "the smaller the absolute quantity of organic nitrogen, and the less the proportionate amount as compared with organic carbon, the better is the

quality of the water, as regards present or actual pollution, and the less likely is the water to contain any organic matters of animal origin." The fact, however, that waters which are entirely uncontaminated by animal matter may still contain a considerable quantity of nitrogen derived from vegetable matter, either growing in the water, or with which it has been in contact, is referred to, and, in Dr. Frankland's view, satisfactory methods of interpretation sufficient for every possible case pointed out.

The most interesting feature of Dr. Frankland's system, as well as the most important in the present connection, is the method by which he determines whether or not a given water has been previously contaminated by sewage or other animal contamination. In making this determination, the following circumstances govern. In the first place, throwing out of consideration the free nitrogen of the dissolved atmospheric air, we may say that the element nitrogen exists in water either as a constituent of ammonia, organic matter, or in combination with mineral substances as nitrites and nitrates. In these several forms the nitrogen constitutes a record of not only the present pollution but of that which is past; thus the organic nitrogen furnishes the record of that portion of the pollution which is a matter of the immediate present, the ammonia a record of that which is past, but so recently as to still constitute an element of danger, while the nitrites and nitrates indicate the pollution which formerly existed but which probably has been rendered innocuous through the action of the forces producing nitrification. In regard to these forces it may be noted that their action is comparatively rapid in the pores of an open soil, while in the water of rivers and lakes they act much more slowly. The nitrites and nitrates, when once formed, however, mark the complete reduction of the nitrogen to the mineral state and, remaining dissolved in the water, constitute "a record of the sewage or other analogous contamination to which it has been subjected since its descent to the earth as rain." In order to obtain a concrete expression for the amount of the previous contamination, the amount of total combined nitrogen contained in solution in 100,000 parts of average London sewage was taken as a standard of comparison. Various analyses show from 7.06 to 8.363 parts of total combined nitrogen in 100,000, but for simplicity a round number—10—was assumed as the total amount of combined nitrogen in solution in 100,000 parts of average London sewage. Inasmuch as this number is considerably higher than that furnished by actual analysis, it is clear that the assumed standard is only a conventional one; hence the indications derived from it, while comparable among themselves, are still only comparable with London sewage by the use of a correction factor, although as used by Dr. Frankland such a correction has not been applied, chiefly because of the essentially varying composition of the sewage itself; from hence it results that a comparison made at one time would only be relatively true at another.

Moreover, different series of results compared with a varying standard could only be compared among themselves by applying vexatious and complicated corrections. The conventional standard was therefore fixed upon as the most convenient, all things considered, that could be obtained.

In estimating the previous contamination in terms of this standard, Dr. Frankland points out that it is necessary to bear in mind that rain-water contains nitrogen in the form of ammonia, nitrites, and nitrates. According to the analysis of twenty-one samples collected at Rothamsted, the amount of nitrogen in these forms was 0.047 parts in 100,000 parts of water. The number 0.032 as obtained from a more limited number of analytical determinations was, however, fixed upon for reasons which are made clear in the Sixth Report of the Rivers Pollution Commission, but which need not be specially considered here.

In arriving at the amount of the previous sewage or animal contamination in any given sample, the amount of nitrogen in the form of ammonia, nitrites, and nitrates is first ascertained by the ordinary processes, and from their sum the number 0.032—representing the nitrogen of the rainfall in these forms—taken; the remainder represents the nitrogen which has been derived from any oxidized animal matters with which the water has been in contact. For instance, a water containing 0.326 parts of nitrogen in the form of ammonia, nitrites, and nitrates has obtained $(0.326 - 0.032) = 0.294$ parts from animal matters. According to the assumed standard of comparison, this amount of combined nitrogen is contained in 2,940 parts of average London sewage; hence such a sample of water is said to exhibit 2,940 parts of previous sewage or animal contamination in 100,000 parts; or 100,000 pounds of the water have contained at some time an amount of organic animal matter equal to that found in 2,940 pounds of the assumed London sewage.

With regard to the other principal determinations of the combustion method, the weight of opinion at the present time apparently is that the attempt to distinguish between the organic carbon and the organic nitrogen is only partially successful. The determination of the total organic nitrogen is, however, by itself a valuable one, which would without doubt be generally used in place of the albuminoid ammonia determination of the Wanklyn process, if it were not for the difficulty of working the method.

The detail of the more important phases of Dr. Frankland's system of analysis is given in the foregoing somewhat at length, because, all things considered, it may be taken as the most elaborate attempt to exhibit the natural history of water by chemical means only that has ever been made. That it has failed to do all that was hoped for it is only due to the complexity of the subject, which does not admit of a complete understanding from any one point of view, but which must be approached from at least four sides—namely, the environmental, physical, chemical, and micro-

scopical—in order to really encompass anything like the whole of the many difficult questions which it involves.

The tendency of the present day is to individualize the various sources of contamination, the dream of the biological investigator being, at any rate, that, through study of the life history and pathogenic effect of the numerous species of minute life which we now know inhabit all waters, we may finally determine, largely by the aid of the microscope, whether or not any given water supply contains anything deleterious to health. In the view of this class of investigators, the microscope is of quite as great or even greater importance in water examinations than the chemist's more elaborate array of retorts and appliances for determining equivalent volumes. This view, too, it may be said, is now generally held by advanced chemists, and we accordingly find such using the microscope as a check on the otherwise uncertain indications of the chemical analysis. It should not be overlooked, however, that the four distinct lines which have been already indicated should be pursued in any case where a complete sanitary analysis is desired, and hence the rational statement of the matter is that the microscopical examination takes equal rank with the chemical. The author, in the course of a somewhat extended study of sources of water supply, has had occasion to frequently decide the question of relative sanitary value of different sources, and has yet to see the case where an intelligent use of the microscope in conjunction with a study of the environment would not furnish decisive evidence on which to decide for or against. The method of examining a source of proposed water supply which he has found the most satisfactory is to spend some little time tramping over the drainage area with a portable outfit for the microscopical examination as his only companion. A sample can be taken, filtered, and the enumeration made in an hour or an hour and a half from the time of taking. In this way we learn to a certainty the actual number of forms of minute life present, there being absolutely no opportunity for changes to take place. That this point is of considerable practical importance will be readily appreciated after one has collected a few samples in mid summer, one portion being examined at once and the other left standing for one or two days before the examination. In the latter case the microscope will be very likely to show large quantities of amorphous matter which will not appear in the portion examined immediately after collecting. Nor is this all. If the same portions are examined chemically, it will be found that the proportionate amounts of free and albuminoid ammonia will be quite different in the second case from what they are in the first. Nevertheless the author believes it is nearly universal practice to not examine samples of water chemically until the second or third day after collection, by which time, unfortunately, such changes have taken place in many cases as to render any deductions from the amounts of free and albuminoid ammonia present relatively worthless.

This remark is especially true in case sewage contamination is present.

And this brings us to another point of great practical importance, namely, as to the possibility of definitely determining by the microscope whether or not sewage contamination is actually present in a given sample of water. For a long time the matter of sewage contamination has been a stumbling-block in the way of satisfactory interpretation of the results of chemical analysis. We have already seen the cumbersome methods of expressing the fact of sewage contamination resorted to by Dr. Frankland in his combustion process, and we may further remark that the extensive application of this method made to polluted river water by Dr. Frankland has been the cause chiefly of the adoption of what must be considered an unnecessarily high standard of purity in the case of streams from which a study of the environment shows sewage contamination to be absent. In the same way Wanklyn, working largely upon sewage-polluted London wells, fixed upon an arbitrary standard, which, while properly applicable to such wells, is little worth when applied to streams and surface waters generally.*

At the present time it may be affirmed that in the case of surface waters the microscope will usually show evidence of sewage contamination when such exists. The cases in which it may not furnish definite evidence are those in which, by reason of the water flowing considerable distances, sedimentation has been sufficiently thorough to remove the kind of evidence which the microscope is fitted to detect. Even when this has occurred an examination of the deposit of mud at the bottom will easily lead to the detection of the specific constituents of sewage. This part of our subject, although capable of yielding practical results of the very highest value, is nevertheless, with the exception of a small amount of work in Germany and England, as yet almost entirely undeveloped.

The beginning of the use of the microscope for detecting sewage contamination in potable water dates from the researches of Prof. Nothnagel, who published, about fifteen years ago, the results of an investigation into what may be termed the fixed constituents of human excrements. Prof. Nothnagel found that there were four substances of almost constant occurrence in faecal matter, namely, muscular tissue, yellow elastic tissue fibre, shreds of fibrous substances, such as fasciæ, and finally spiral and free vegetable cells. All of these are so far capable of resisting the action of the digestive fluids that they pass away in the faecal matter either in an unchanged or so far unchanged state that they may

* On the necessity for varying chemical standards for different classes of water, see a Preliminary Report of a Chemical Investigation into the Present and Proposed Future Water Supply of Philadelphia, by Albert R. Leeds, Ph. D., in *Ann. Rept. Phil. Water Dept.*, 1883, p. 243.

Also see *The Odor and Color of Surface Waters*, by Thomas M. Drown, M. D., Prof. of Analytical Chemistry in the Massachusetts Institute of Technology, etc., in *Jour. New. Eng. W. W. Assn. for Mch.*, 1888, pp. 2-29.

be as easily recognized as are other substances susceptible of definite microscopical determination.

But this is not all. The researches of Prof. Tidy in England and of Dr. Drown in this country have shown that sewage, when discharged into a stream, and especially into a sluggish flowing one, not only quickly removes the dissolved oxygen, but its effect is, further, such as to keep the oxygen permanently, nearly, or actually *nil* near the bottom.* Deposited sewage may, therefore, remain at the bottom of a polluted stream for months almost without change, and may be, by the use of the microscope, identified as such through the medium of the method here discussed. Thus far two English microscopists, namely, Drs. Beale and Sorby, are about the only persons to pursue this line of study to a really practical conclusion. A paper by Dr. Beale may be found in the journal of the Royal Microscopical Society for February, 1884.† In it Dr. Beale gives in detail the method of examining sewage muds which he pursued in the case of twenty-five samples from the Thames' mud banks, together with the more important results which he obtained. His results are qualitative purely.

Dr. Sorby about the same time worked out a method of quantitatively determining by the use of the microscope the amount of the fixed constituents of sewage in a given volume of water and applied it in an elaborate investigation of the pollution of the river Thames, undertaken at the instance of what is known in sanitary literature as the Royal Commission on Metropolitan Sewage Discharge of 1884.‡ In his communication to that commission Dr. Sorby gives in great detail the results of a large number of determinations of the fixed constituents of human excrements, as found in samples of Thames' water taken at different stages of the flow. Rather curiously, however, he fails to point out just the method pursued in obtaining his quantitative results, and in consequence the work has never received the attention which its importance would otherwise have secured for it. Nevertheless Dr. Sorby's great reputation as a working microscopist may lead us to accept his results as essentially correct, even though we lack the detail of the method pursued. Some of his more important conclusions may be briefly stated as follows:

(1) There is no serious difficulty in determining with the microscope the relative amount of human *fæces* or of horse manure from street washings in any given sample of water or deposit of mud.

(2) The moderately fine portion of human *fæces*, amounting to about 31 per cent. of the whole, is the portion which yields the greatest amount of valuable information. This portion con-

* For a recent exposition of this part of the subject see as follows: (1) On the Amount of Dissolved Oxygen contained in Waters of Ponds and Reservoirs at Different Depths; and (2) The Effect of the Aeration of Natural Waters, both by Dr. Thomas M. Drown. 23d An. Rept. Mass. St. Bd. Health (1891), pp. 373-394.

† The Constituents of Sewage in the Mud of the Thames. By Dr. Lionel S. Beale.

‡ See volume ii, Rept. of Roy. Com., etc., Report of Microscopical Investigation, with detailed results, by Dr. H. C. Sorby, pp. 169-184.

tains vast numbers of more or less perfectly recognizable fragments of muscle derived from the meat eaten as food. The fragments are not in the condition of cooked meat, but are so modified by the digestive process as to be no longer soluble in a warm acid solution of pepsin. They are also insoluble in a dilute warm solution of caustic potash. Again, they resist decomposition for a far longer time than cooked meat, when kept in water: at the same time showing the microscopical structure of muscle with such marvellous perfection that they cannot be confounded with any other object.

(3) Human faeces vary in composition according to the food eaten. Green vegetables furnish many spiral vessels, while faeces from oatmeal abound in the hairs of oats.

(4) Horse excrements play the most important part in street washings. Their most characteristic objects are hairs of oats and spiral vessels derived from straw or green fodder.

(5) It is quite within the possibilities of our present knowledge to prepare a microscopical scale of comparison by the use of which to estimate the amount of sewage contamination in any given sample of water.

The foregoing discussion presents a few of the points to be taken into account in determining the various circumstances affecting the quality of a public water supply. Without pretending to legitimately make all the deductions from this inadequate presentation of some of the elements of the subject, we may still lay the following down as practical points to be borne in mind when studying questions of sanitation in relation to public water supplies, namely:

(1) The circumstances affecting the quality of a public water supply are of an exceedingly complex nature. So true is this that what appears to be a cause of disease at one time may possibly become under different conditions the source of immunity from danger. Hence a knowledge of the detail is indispensable for a really rational decision in nearly every case.

(2) The most complete system of chemical study thus far devised is the combustion method of Dr. Frankland, but the difficulty of working it has prevented its general adoption in actual work. At the present time, by reason of the perfection of the systems of biological examination, the simpler albuminoid ammonia process of Wanklyn answers all the requirements of the purely chemical study.

(3) Dr. Frankland's method of estimating the previous sewage or animal contamination is interesting as showing how completely he realized, twenty years ago, the value of more definite information about the natural history of water.

(4) The working out of exact methods of studying the bacteria about ten years ago was a great step in advance in determining the sanitary relations of potable water.

(5) The working out in the last three years of exact methods

of studying the microscopical life is another step which bids fair to advance our accurate knowledge of the sanitary relations of potable water as much or even more than a knowledge of the bacteria. For this latter advance we are chiefly indebted to the liberal policy of the Massachusetts State Board of Health.

(6) At the present time all studies point to the conclusion that a water once polluted with the excrements of either domestic animals or human beings is unsafe for domestic use for a long time thereafter.

(7) As between the pollution of domestic animals or human beings, the weight of recent evidence is, other things being equal, that the pollution from animals is the source of the greater danger, for the reason that intercommunicable infectious diseases are more virulent when communicated from animals to men than from men to animals. It is found, too, that domestic animals are quite as liable to infectious diseases as are human beings.

(8) The self-purification of a stream, pond, or lake receiving sewage may proceed from (a) the chemical force of oxidation; (b) the biological force of reduction of organic matter to harmless forms through the medium of life processes, and (c) sedimentation. An apparent self-purification may also be attained by mere dilution. In regard to oxidation and biological reduction, the difficulty at present is to determine when they are complete: while sedimentation is likely to be a source of grave danger by reason of furnishing a field in which disease germs may reproduce themselves indefinitely.

(9) It is clear from the preceding that running streams which receive sewage may be unsafe sources of water supplies for many miles below the point of inflow. Incidentally it may be remarked that the recent investigations in relation to the typhoid germ which have been made in Massachusetts and other places have enforced this point in another way, which need not be specially referred to at this time.

(10) Absolute immunity can be obtained by drawing water supplies from areas entirely free from animal pollution of every sort and kind. When this is impracticable intelligent supervision may be relied upon to reduce somewhat the danger of pollution.

(11) Filtration will also improve the quality of polluted water supplies.

(12)—As a fair practical summation of the whole matter, we may say, in conclusion, that the water-works manager of the present day, in addition to being a business man and a working engineer, needs to be something of a chemist and biologist as well, to this extent, that he may be able to quickly appreciate all the circumstances affecting the quality of a public water supply.

American Microscopical Society.—The meeting for this year will be held at Madison, Wis., August 14, 15 and 16. A large attendance is hoped for.

Diatoms of the Connecticut Shore.—V.

BY WM. A. TERRY,

BRISTOL, CONN.

M. Tempère of Paris writes that in cleaning the samples of earth from the Leete's Island deposit he failed to find many varieties which were shown in the slides previously sent to him. The earth was thrown out in digging for foundations for a railroad bridge across Leete's creek. After digging some seven feet, piles were driven through the deposit 20 or more feet and the abutment was built up on the piles. The earth was carted away in wheelbarrows and dumped. The strata became hopelessly mixed. Besides, the same stratum varies greatly in richness within a few feet of horizontal distance, as will be readily understood when the method of deposit is studied. The rise of the tide along the Connecticut shore averages about six feet, causing powerful currents in the bays and inlets, which deposit the diatoms in eddies and basins. As frequent changes occur, the diatoms are very unequally distributed. In describing the diatoms of Morris cove, in an article published in this JOURNAL in Dec'r, 1888, I showed how certain varieties grow in narrow belts or zones, limited by the depth of water. These belts were only a few feet in width but some miles in length, and occurred one after the other from the shallow margin to about 15 feet depth of water at low tide. Subsequent investigation has shown that this arrangement is permanent, and I can always rely upon finding certain varieties in active life along a line at a particular depth and distance from the beach. This shows how useless it is for an explorer to make a dip here and a sounding there, and go away with the idea that he understands the diatoms of any locality. Persistent and systematic search is needed in order to arrive at anything like the truth. The following list is from the 15th fascicule of the collection of J. Tempère and H. Peragallo.

NO. 492. LEETE'S ISLAND, U. S. A., NO. 1. LOURD.

<i>Actinocyclus chrenbergii</i> Ralfs.	<i>Nitzschia scalaris</i> Sm.
<i>Actinopterychus undulatus</i> E.	<i>sigma</i> Sm.
<i>Amphiprora elegans</i> Sm.	<i>Pleurosigma affine</i> Grun.
<i>pulchra</i> Bail.	<i>balticum</i> Sm. var.
<i>Biddulphia pulchella</i> Gray.	<i>strigosum</i> Sm.
<i>rhombus</i> Sm.	<i>wansbeckii</i> Donk.
<i>Coscinodiscus excentricus</i> E.	<i>Pyxilla dubia</i> Grun.
<i>oculus iridis</i> E.	<i>Raphoneis gemmifera</i> E.
<i>radiatus</i> E.	<i>Rhabdonema adriaticum</i> K.
<i>Lithodesmium undulatum</i> E.	<i>Scoliopleura tumida</i> Breb.
<i>Melosira sulcata</i> K.	<i>Stauroneis salina</i> Sm.
<i>Navicula formosa</i> Greg. et var.	<i>Surirella fastuosa</i> E. var.
<i>fusca</i> Greg.	<i>febigerii</i> Lewis.
<i>lyra</i> E. var.	<i>striatula</i> Turpin.
<i>granulata</i> Breb.	<i>Terpsinoe musica</i> E.
<i>marina</i> Ralfs.	<i>Triceratium antediluvianum</i> E.
<i>Nitzschia circumscuta</i> Bail.	<i>favus</i> E.

No. 493. LEETE'S ISLAND, U. S. A., No. 1 LEGER.

<i>Actinocyclus ehrenbergii</i> Ralfs.	<i>Navicula hennedyi</i> Sm.
undulatus E.	interrupta K.
<i>Amphora cingulata</i> Cl.	marina Ralfs.
<i>Biddulphia aurita</i> Breb.	peregrina E.
<i>Coscinodiscus excentricus</i> E.	smithii Breb. var.
<i>Epithemia musculus</i> K.	<i>Nitzschia sigma</i> Sm.
<i>Melosira sulcata</i> K.	<i>Rhabdonema adriaticum</i> K.
<i>Navicula didyma</i> K.	<i>Scoliopleura tumida</i> Breb.
distans Sm.	<i>Surirella recedens</i> A. S.
formosa Greg.	

No. 494. LEETE'S ISLAND, U. S. A., No. 2.

<i>Actinoptychus undulatus</i> E.	<i>Navicula interrupta</i> K.
<i>Auliscus pruinosis</i> Bail.	lyra E.
<i>Campylodiscus echeneis</i> E.	marina Ralfs.
<i>Coscinodiscus excentricus</i> E.	<i>Nitzschia circumsuta</i> Bail.
marginatus E.	scalaris Sm.
oculus iridis E.	tryblionella Grun.
radiatus E.	<i>Pleurosigma affine</i> Grun.
symbolophorus E.	wansbeckii Donk. var.
<i>Biddulphia rhombus</i> Sm.	<i>Pylla baltica</i> Grun.
<i>Hyalodiscus radiatus</i> E.	<i>Rhabdonema adriaticum</i> K.
<i>Melosira sulcata</i> K. et var. coronata.	<i>Scoliopleura tumida</i> Breb.
<i>Navicula distans</i> Sm.	<i>Stephanopyxis turris</i> E.
fischeri A. S.	<i>Stictodiscus californicus</i> Grev.
formosa Greg.	<i>Surirella striatula</i> Turpin.
hennedyi Sm.	<i>Triceratium antediluvianum</i> E.
humerosa Breb.	favus E.

No. 495. LEETE'S BAY, U. S. A.

<i>Actinocyclus ehrenbergii</i> .	<i>Melosira sulcata</i> K.
ralfsii var.	<i>Navicula lyra</i> E.
<i>Actinoptychus undulatus</i> E.	formosa Greg. †
<i>Auliscus pruinosis</i> Bail.	<i>Nitzschia circumsuta</i> Bail.
<i>Biddulphia pulchella</i> Gray.	tryblionella Grun.
rhombus Sm.	<i>Rhabdonema adriaticum</i> K.
<i>Cerataulus turgidus</i> E.	<i>Pylla baltica</i> Grun.
<i>Campylodiscus echeneis</i> E.	<i>Pleurosigma balticum</i> var.
<i>Coscinodiscus oculus iridis</i> et var.*	<i>Triceratium antediluvianum</i> E.
<i>Eupodiscus argus</i> E.	favus E.

No. 496. LEETE'S CREEK, U. S. A.

Cette récolte contient les mêmes formes que les précédents avec quelques frustules de *Cerataulus polymorphus*.

No. 500. STONY CREEK, U. S. A.

<i>Actinoptychus undulatus</i> E.	<i>Nitzschia scalaris</i> Sm.
<i>Amphiprora elegans</i> Sm.	sigma Sm.
<i>Cerataulus polymorphus</i> E.	tryblionella Grun.
<i>Coscinodiscus oculus iridis</i> E.	<i>Pleurosigma affine</i> Grun.
<i>Navicula formosa</i> Greg.	balticum Sm.
kamorthensis Grun.	decorum Sm.
smithii Breb.	elongatum Sm.
<i>Melosira nummuloides</i> .	<i>Scoliopleura tumida</i> Breb.
<i>Nitzschia obtusa</i> Sm.	<i>Triceratium favus</i> E.

* Cette préparation montre bien les transitions insensibles qui unissent cette espèce au *Coscinodiscus radiatus* et le peu de valeur des distinctions spécifiques de ces deux formes.

† Et de grandes formes d'eau douce probablement accidentelles, *dactylus*, *gigas*, *major*, *alpina*, etc.

From what has been said, it may readily be seen that if M. Tempère had examined more samples, from other parts, and strata of the deposit, the above list would have been greatly extended. *Navicula permagna* and *N. maculata* are not mentioned, but they occur in extraordinary abundance, the latter in several very fine types in parts of the deposit. *Actinocyclus barkleyi*, *A. ralfsii*, *A. chrenbergii* and *A. crassus* are recognized in the Connecticut shore diatoms. Of these *A. barkleyi* is by far the most abundant. The pseudo-nodule, so easily seen in *A. chrenbergii* and in *A. crassus* and generally in *A. ralfsii*, appears to be absent in the majority of valves of *A. barkleyi*. Although this is one of the heaviest of diatoms and appears so dense when mounted in balsam, valves which have never been dried are so transparent in water that their markings can scarcely be seen. This shows some peculiarity of structure in which they differ from other diatoms. I have lately found *A. barkleyi* of precisely similar type to that of the Connecticut shore in material sent me from distant localities.

Dr. Edwards sends earth from different localities on the New Jersey shore which contains the same *Actinocyclus*, and mud from a swamp in Melbourne, Australia, has the same associated with *Navicula cancellata* and *Hyalodiscus subtilis* and *H. radiatus*. On the Connecticut shore, *N. cancellata* occurs abundantly in tide pools in the marshes with *P. balticum*, and *Hyalodiscus* is found in deeper and more saline waters.

In Cunningham's find in a marsh near Mobile river is the same *Actinocyclus* again, with remarkable specimens of *Terpsina musica*, which occurs only sparingly on the Connecticut shore. Soundings from near Cuxhaven, North Sea, contain *Actinocyclus chrenbergii* and *A. crassus*, with abundant *Eupodiscus argus* and *Triceratium favius* and an occasional *Navicula maculata*, precisely similar to those of New Jersey and to the smaller type from Leete's Island.

I find in the Morris creek material *Actinocyclus tenuissimus* and *Actinoptychus subtilis* (Van Heurck's Diatoms of Belgium, plate cxxiv, fig. 7, and plate cxxv, figs. 2 and 3). I find also a form larger than any of the others, which, instead of the small marginal spines, has elevated ridges extending about one-third the distance to the centre of the valve, and which has striation decidedly different from any other. Plate cxiv, fig. 9, shows *Triceratium brightwellii* West, var. *trigona* (*Ditylum trigonum* Bailey), which I have found at Branford, Conn. Figs. 5 and 8, showing entire frustules, are imperfect, as the central spines are broken. The Branford forms show longer spines terminating in a knob or ball.

Soundings from the oyster beds at Clinton, Conn., show numerous minute varieties, many of which are rare. The larger forms are chiefly varieties of *Coscinodiscus* and of other kinds previously mentioned, with *Pleurosigma balticum*, *P. america-*

num, *P. decorum*, etc., but perhaps the most interesting is a long, narrow, and very delicate *Pleurosigma* which is new to the writer. It has the median line slightly flexed, outline nearly straight. The living frustule appears entirely straight, the front and side views having the same outline. This form enables it to pierce through obstructions with ease. This it does in a lively manner. The striae are so fine and delicate that an objective which resolves *P. angulatum* and *P. elongatum* with ease fails entirely with this. It is longer than *P. intermedium* of Puget Sound. Its outline presents a more graceful curve and its form is more delicate.

The material also contains *Synedra* from *S. superba* down to very minute kinds; the elegant *Schizonema* (*Stauroneis*) *cruciger*, with many others. *Bacillaria paradoxa* is in abundance—another instance of its occurrence in deep saline water. *Cymatopleura marina*, which appears like a *Nitzschia*, many rare *Navicula*, *Encyonema*, etc., are present, but the material requires further examination in order to present a description of value.

PROBLEMS.

NOTE.—Topics are suggested occasionally upon which a variety of views would be desirable. The problems will be stated under this heading as they arise, and persons having facts or opinions pertinent thereto are invited to transmit the same, which will be published under the heading, "Letters to the Editor."

(9) **Monochromatic Light.**—What is the most convenient or best method of producing monochromatic illumination? The methods by sodium flame and ammonio-cupric solution seem to be capable of easy application, but I have been unable to find formulæ for the solution or manner of producing the sodium flame in any of the ordinary works on the microscope. As many eminent authorities hold that the next considerable advance in microscopy must be through improvements in illumination by monochromatic light, and as the performance of ordinary achromatic objectives is improved by its use, the subject becomes one of importance.—F. P.

LETTERS TO THE EDITOR.

NOTE.—This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.

(12) **Blood Stains.**—In answer to the question of H. M. F., relating to the preservation of blood-corpuscles (page 50, Febru-

ary number). I can say that I have had considerable experience in this line of work, but know of no permanent way of preserving the corpuscles after mordanting from a stain beyond a week or ten days' time.

For mordanting or separating the corpuscles, a solution of 33% of caustic potash is superior to all else. If carefully sealed, they may be preserved a short time in this solution; not, however, without the formation of some crystals from the potash. Probably a better solution for preserving and mounting the corpuscles would be a solution of the glycerin of the same specific gravity of the blood serum.

W. N. SHERMAN.

MERCED, CAL., *March 20, '93.*

(13) **Blood Stains.**—Replying to Problem No. 4, on page 50 of the *JOURNAL* for February, 1893, I would say:

Blood-corpuscles may be restored to perfect form and shape (not all of them) from dried blood, and are so proven by measurement, which I have demonstrated to my satisfaction many times. It cannot always be done by the methods (solutions) mentioned in the reply to Question 139, H. M. F., on page 45, vol. 1, No. 3, of the *Microscope* for March, 1893, but with the caustic potash solution I have often succeeded in demonstrating and measuring them in 30 minutes. I can demonstrate this assertion positively. The New York Medico-Legal Society recently asserted that any skilful microscopist could distinguish human blood from that of the domestic animals, and a great many scientific men coincide with it in this view.

The opponents to the identification of blood have twice made an effort to use the American Microscopical Society to sustain their side of the question, but have as often failed. The proof of their perfect restoration can be demonstrated and illustrated by photomicrographs.

W. N. SHERMAN.

MERCED, CAL., *April 19, 1893.*

(14) **Cheaper Instruments.**—We think that our Star Microscope ought to meet the wants of your subscribers who require a cheap instrument. For a little over \$20, they get a good outfit. This is a specially low price, but if it is too high we can get to work and possibly make a cheaper instrument. This one has a joint and it might be possible to make one very much cheaper than this. We want your ideas on the subject.

WILLIAMS, BROWN & EARLE.

PHILADELPHIA, *February, 8 1893.*

(15) **A Microscopical Index.**—To get the greatest value out of my file of microscopical journals, I bought a letter file for fifty cents, made of stout paper. It has an index. After reading a periodical carefully I write upon paper $2\frac{1}{2} \times 3$ inches a reference to the title of each item, adding, of course, the volume and number of the journal. I file these slips alphabetically in the compartments of the indexed file. This in time will make a complete

cyclopaedia of microscopy. It is very convenient and contains much more information than the indexes published at the end of each volume.

For instance, mention could not be made in the usual index of the various methods described in articles whose titles are general. A paper on manipulation, mounting, staining, section cutting, etc., would furnish me a great number of slips. But these minute points are obtainable only by reading carefully every part of an article; but this pays in the knowledge which one accumulates. I have learned more of the subject the past three weeks, while indexing some back volumes, than I could have learned in many years of careless reading. All newspaper clippings are numbered consecutively and indexed with the rest. A. P. WEAVER.

March 13, 1893.

(16) **Microscopical Titles.**—This scheme will be of undoubted usefulness to writers on microscopical topics. I shall probably use it in order to test it in practice. But to the general reader, while the list will be useful, the labor of cutting and arranging will perhaps seem beyond what he wishes to put forth. I enclose a list of titles and can send more if called for.

EDWARD GRAY.

SANTA CRUZ, *March 24.*

(17) **Titles.**—My opinion is that this leaflet is a good thing. I will use only a part of it, as I have but few books on microscopy. The type is too small and the titles too crowded. I would recommend using the larger type, and some leads and a rule between the items.

GEO. R. LUMSDEN.

GREENVILLE, CONN., *March 31.*

(18) **Titles.**—I am pleased with your scheme of getting up an index to microscopical literature, and can supply you with 100 or more titles.

H. M. WHELPLEY.

ST. LOUIS, MO., *March 17.*

(19) **Titles.**—By all means continue your titles of microscopical publications.

M. D. EWELL.

CHICAGO, *March 16.*

(20) **Titles.**—I enclose a list of books on microscopical technique taken from my card catalogue which may be of service to you in continuing your list.

GEO. C. FREEBORN.

NEW YORK, *March 14.*

(21) **Titles.**—I think your plan of a bibliography of the microscope a very good one. Should you continue it, I will gladly send you some titles from a bibliography which I have been collecting for several years.

E. G. LOVE.

NEW YORK, *March 18.*

(22) **Titles.**—Your suggestion as to titles is excellent. To show my appreciation of its wisdom and value I enclose a list of titles. If others will do the same it will prove very useful. If the titles were spaced asunder there would be no fault found, I think.

O. S. WESTCOTT.

CHICAGO, *March 22.*

(23) **Titles.**—I should like to see a bibliography of the original articles that appear in microscopical technique and in the various sciences in which the microscope is used. A complete list of books, papers, etc., etc., is good. I have a card catalogue of all you published already. For indexing the periodicals, etc., the size of card that you suggest is good, but for indexing articles, some prefer other sizes. A printed label is, of course, much better than a written one.

V. A. MOORE.

WASHINGTON, *March 22.*

(24) **Titles.**—The scheme is admirable. I wish you would include the price and number of illustrations. These facts are of value to one selecting books to purchase.

A. P. WEAVER.

JACKSON, *March 24.*

(25) **Titles.**—I was struck with this plan. It must be very useful. I would suggest, however, (1) larger type, (2) names of authors in bolder type, (3) additional space between the items. The small type may be trying to the eyes of middle-aged people.

J. P. THOMPSON.

PORTLAND, *March 22.*

(26) **Titles.**—I have used such a scheme as you propose for several years and your lists would have saved me a good deal of trouble. I find a few new items in your February list. I will help on this work as soon as I get settled.

J. M. STEEDMAN.

AUBURN, ALA., *March 30.*

(27) **Titles.**—The scheme I think a good one. I should advise that each title be printed twice, so that two cards can be made—one for authors and one for subjects. I have used such an one for a long time; every article worth keeping track of is entered. Leave space between the titles so as to make it easier to cut and paste them.

H. L. OSBORN.

ST. PAUL, MINN., *March 20.*

(28) **Titles.**—I do not see the utility of a mere list of books, as but few of us have so extensive a library as to render it necessary to catalogue them, but a list of all microscopical books, giving a short review of the contents and the prices, would be a consideration and assist intending purchasers.

S. G. SHANKS.

ALBANY, N. Y., *March 27.*

MICROSCOPICAL APPARATUS.

Micrometer Calipers.—This instrument is convenient for measuring the thickness of cover-glasses. That it was not mentioned by Prof. S. H. Gage in his recent volume was purely an oversight and not a lack of appreciation nor of knowledge. Prof. Gage writes us that when he tried the calipers in comparison with cover-glass measurers the results obtained on the same glasses

were practically the same, but the time and ease of manipulation he regarded so much in favor of the pieces of apparatus especially constructed for the purpose that they alone seemed to him really practicable for quickly and easily measuring all the cover-glasses that would be used in a histological laboratory in three months.

MICROSCOPICAL MANIPULATION.

Cleaning Mortars.—Make a strong solution by dissolving caustic soda in a large bottle of water, which can be kept near the water-sink. First rub the inside of the mortars or other utensils well with sawdust, then use the caustic alkali solution, which will remove either resins or oils. Alcohol would do, but it is expensive.

Cleaning Steel Instruments.—Clean the instruments by rubbing with wood ashes and soft water. Then soak them in a weak solution of hydrochloric acid in water (about ten to fifteen drops to the fluid ounce) for a few hours, to remove the rust and grease. Then wash them well in pure soft water. The next step is to place them in a bath consisting of saturated solution of tin chloride. Let them remain ten to twenty-four hours, according to the coating desired. When removed from the bath, wash them clean in pure water and dry well. When the job is well done, the steel will appear as if nickel plated.—*Medical Brief.*

BACTERIOLOGY.

Soft Chancres.—Some Russian physicians have examined fifteen cases of soft chancres as follows: Having washed out an ulcer with a permille solution of corrosive sublimate, they extracted (by means of a sterilized needle) some discharge with detritus, spread the matter over a glass plate, and stained the specimen with Sahli's solution (sixteen grammes of a five per cent. solution of borax, twenty grammes of a saturated aqueous solution of methylene-blue, and twenty-four grammes of distilled water), after which they examined it under the microscope (Leitz's Ocular No. 3, and immersion system one-half). In every one and all of the cases there were detected the characteristic microbes first described by Dr. Ducrey, of Naples. In other words, there were invariably present peculiar short and relatively rather thick rod-shaped bacteria, measuring from 1.48 to 2 m. in length, and from 0.5 to 1.0 m. in width, and resembling the figure 8 (Ducrey, Petersen), or dumb-bells (Krefting). The bacilli were partly lying free (singly, or in rows, or in groups), and partly embedded within leucocytes. In the discharge taken

before any treatment, the rods were met with in fairly large numbers; later on, as the healing process advanced, their numerical strength gradually and steadily decreased, while after the ulcer had become clean or healthy looking the micro-organisms disappeared altogether.

MEDICAL MICROSCOPY.

The Centrifugal Method of Preparing Urine for Microscopical Examination.—A specimen of urine was divided between two examiners. One employed the centrifugal method, found no casts, and insured the man who was being examined for life insurance. The other allowed the urine to stand twelve hours in a conical glass, found hyaline casts, and declined the risk. This would seem to condemn the centrifugal method.

Carbolic Acid Poisoning.—By accident a 5 per cent. solution of carbolic acid was administered to a child 10 months old in connection with an enema. Sulphate of sodium was injected as an antidote. During the first two days afterward the urine was turbid and dirty green, contained some albumen, and gave carbolic acid reaction. Microscopical examination of sediments revealed the presence of scanty red blood-corpuscles, epithelium, and abundant crystals of uric acid.

MICROSCOPICAL NOTES.

American Microscopical Society.—The next meeting of this society will be held at Madison, Wis., on Monday, Tuesday, and Wednesday, August 14, 15, and 16, 1893.

Dismissed by Secretary Morton.—Secretary Morton has ordered the dismissal of forty-one assistant microscopists, one clerk, and a book-keeper attached to the Bureau of Animal Industry and assigned to duty in Chicago. The dismissals take effect April 22. The reason for the dismissal is the reduced condition of the work.

Correction.—Throughout the article printed on pages 80-83, March number, the word spelled *Paramecium* should, according to the author, be spelled *Paramaccium*. The word Vorhöfe is a plural form and not singular as indicated in the article.

MICROSCOPICAL SOCIETIES.

WASHINGTON, D. C.—L. M. MOOERS, *Sec'y*.

February 14, 1893.—Dr. E. A. Gibbs read a paper on Apochromatic Objectives. Dr. W. W. Alleger read a paper on the preparation and mounting of micro-chemical crystals. Two new members were elected.

SAN FRANCISCO, CAL.—W. E. LOY, *Sec'y.*

March 1, 1893.—Three new members elected. The donations to the cabinet were numerous, and included stained and unstained slides of the alga *Volvox globator*, from L. M. King; from A. H. Breckenfeld a slide of crystallized gold, the abrasions from a quantity of coin shipped from Australia; from Dr. A. M. Edwards, thirteen slides, illustrating the "sunken coast" diatomaceous deposits of New Jersey; from E. Thum, Leipzig, six slides of diatoms from the Los Angeles earth and three vials of cleaned material.

The society's library was increased by a complete set of the "Proceedings of the American Microscopical Society," a complete file of the *Journal of the Quekett Club* to date, and Strassburger's "Manual of Vegetable Histology," translated by A. B. Hervey.

R. H. Freund exhibited a beautifully stained preparation of *Amœba proteus*, showing the granules very strongly, and also a preparation of *Spirogyra*, stained with methyl blue, in which the nuclei were very marked.

Dr. S. M. Mosgrove, of Urbana, Ohio, assistant secretary of the American Society of Microscopists, was present as a visitor, and gave an interesting account of the work of that larger society.

The lecture of the evening was by Dr. Gustav Eisen, on the structure of *Oligochæta*, or the minute angle-worms. The class is divided into two extreme groups—land oligochæta and water oligochæta. The former are the lowest developed, the latter the highest. The water forms are characterized by having only two longitudinal vessels, while the higher oligochæta have three longitudinal blood vessels. One intermediate group is called *Ocnërodiclidæ*, which shows characters of both groups. The internal structures were shown to be highly differentiated, consisting of all the various organs known in the highest animals, such as alimentary canal, brain and central ganglion, kidneys and sexual organs. These animals are hermaphrodites, and lay their eggs in capsules or cocoons in the water. The blood is red and pulsating. Lately some very interesting and new forms have been found on the Pacific Coast, which show their internal organs to be quite different from those forms described at first. The genera especially dwelt on were *Ocnërodiclus*, *Gordiodiclus*, and *Pheniodiclus*, the first and last being Pacific Coast forms, while the other is African and West Indian. The lecture was illustrated by slides shown under high and low-power lenses.

LINCOLN (NEBR.) MICROSCOPE CLUB.—ROSCOE POUND, *Sec'y.*

February 28, 1893.—The president's address was by Mr. Woods, upon "Recent Advances in Microscopy." Mr. Dales spoke on the Brownian movement, illustrating his paper with a number of preparations. He showed that in old slides the move-

ment was often due to the presence of bacteria and that the movement ceased when the slides were sterilized. Prof. Bessey exhibited a new Reichert stand and objectives which interested the members very much. Mr. Saunders exhibited specimens of *Isaria filamentosa*.

March 28.—Three new members elected. Mr. Dales spoke further as to Brownian movement and exhibited additional slides illustrating his views. Mr. Woods exhibited a B. and L. stand and accessories. Mr. Kenyon showed a Zeiss stand and objectives. Prof. Bessey made remarks on the stands. Prof. Bruner exhibited a projecting apparatus by Leitz. Mr. Hartley gave an abstract of Hatgini's work in inoculating with cholera. Mr. Kenyon showed a section of the eye of an embryo grasshopper.

NEW PUBLICATIONS.

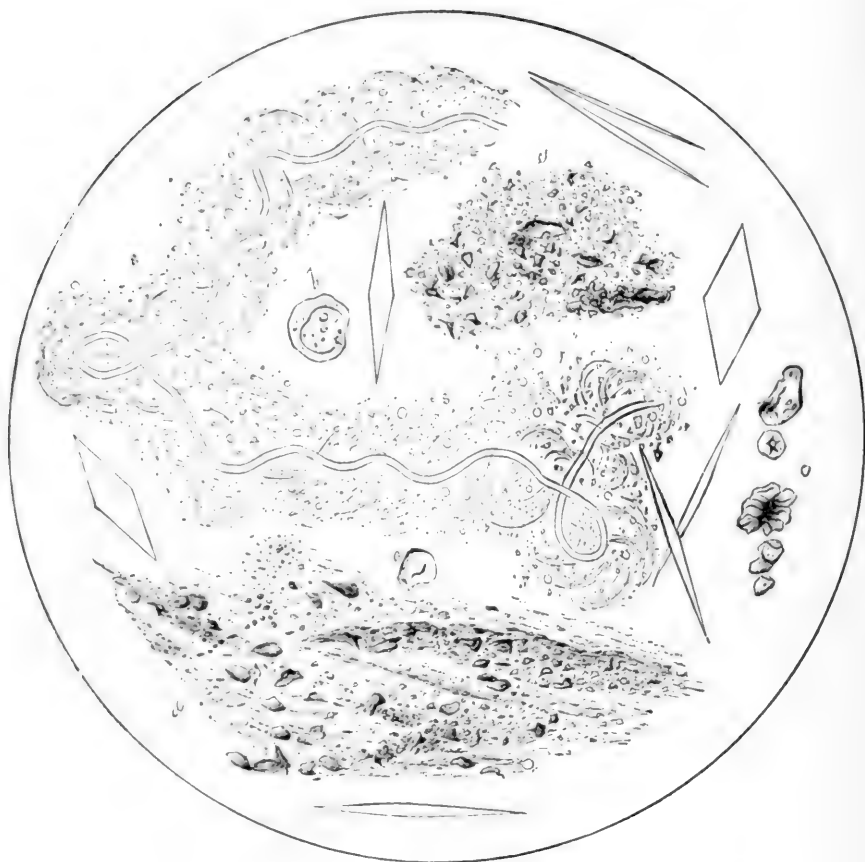
Domestic Science. By James E. Talmage, Ph. D., Salt Lake City, Utah. Pp. 389, 100 cuts.

We have been very much gratified to receive a second edition of this book and to find the improvements which we suggested in the first edition to have been made. We have now nothing but praise to utter regarding Doctor Talmage's work. He has the happy faculty, possessed, or at least exercised, by but few scientists, of being able to interest unscientific people in scientific truths. There really ought not to be that gulf between scientists and common people which technical utterances tend to perpetuate. Could we have a few hundred books like this there would be hope of eventually obliterating the distinction between science and common sense which now exists. And could the rural people, as well as the lower classes of urban people, learn the simplest teachings of science regarding domestic affairs, health, sleep, drink, food, etc., one great step would have been taken towards an improved social condition. Science is able, if it will, to teach enough regarding life to largely destroy the unhappiness and poverty of the world. The author of this book is a missionary to the masses. As suggested before, we should like to see this book in every district school in America.

The Ancient Pit-Dwellers of Yezo, Japan. By Romyn Hitchcock. Washington, 8°, 1892, pp. 11, plates 9.

This pamphlet, by the former editor of the *A. M. M. Journal*, has resulted from the study of a people among whom Mr. Hitchcock lived for two years, and is illustrated with photographs taken by himself. The matter will be of interest to ethnologists but not to microscopists, excepting those who personally knew our predecessor. Copies can probably be obtained gratuitously by addressing the National Museum.

ASTHMATIC SPUTUM.



BY

EPHRAIM CUTTER, M.D., LL.D.

THE AMERICAN

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No. 6.

On the Microscope in Medicine.—I.

BY EPHRAIM CUTTER, M. D., LL.D.

NEW YORK.

SPIRILINA SPLENDENS OR *S. ASTHMA*.

[WITH FRONTISPIECE.]

This is a beautiful alga, parasitic on man, and found in the sputum of asthma, hay fever, or of those predisposed to these diseases. In 1877, or thereabouts, I saw it for the first time in the sputum of a very nervous invalid lady, who earnestly solicited a careful examination, in order to settle the exciting cause of her faucial neurosis. I did not know what the vegetation was till Dr. Salisbury showed it to me in asthmatic sputum. He said he discovered it in 1856, or thereabouts, and called it *Spirilina splendens*. He has since changed name to *S. asthma*. It was called *Spirilina* because it was often coiled and curved like a spiral spring, and *splendens* because it is so lustrously luminous and appears, especially under an inch objective and one-inch eyepiece, like a highly burnished gold wire. It is not found in all cases of asthma, because it may escape observation.

I remember an asthmatic of forty years' standing whose sputum I studied twice a week for a year before I found the *S. asthma*. I found it in a case of fibrous consumption *without asthma*, though there was plenty of granular and encysted gravel in the sputum, as in the sputum morphologies of asthma. I have found the *S. asthma* in my own case, though I never had asthma, but have had bronchitis and expectorated lung calculi on two distinctly remembered occasions. Still, when one considers that asthmatic paroxysms are produced by some exciting causes, acting on a system previously prepared by predisposing causes, to wit, the gravel of the lungs following improper feeding, it is possible for an asth-

DESCRIPTION OF THE PLATE.

a, b, c, = massive gravel; d, e, = granular gravel. The acicular and double-pointed crystals are very common.

s, = *Spirilina asthma*. For much better and more beautiful cuts see *The Relation of Alimentation and Disease*. J. H. Salisbury, LL.D., New York, J. H. Vail & Co., 1888, plates xvi and xvii, which were ready for the press in 1862. Some call *Spirilina asthma* Curschmann's spirals, and the above crystals Charcot Leyden's; but unless it is shown that these gentlemen made their discoveries before 1862 the priority must be given to America for this beautiful and useful work of the microscope.

matic to be loaded like a gun ready to go off when the trigger is pulled, and that the explosion should be the paroxysm of asthma. It is possible to have the *S. asthma* without a paroxysm. In my own case it is possible I might have contracted or sowed the plant from studying for so many years specimens which contained *Spirilina asthma*, especially as my breath directly passes over the specimens on the stage of the microscope. I have been such an enthusiastic admirer of the beauties of the *S. asthma* that I could not help lingering long and delightedly over this American contribution to clinical medicine. The modes of propagation are not known, and I may be wrong as to the idea of my catching it through the breath. It is a parasitic plant to be studied, and the object of this paper is to call attention to it, have it better known and its biology better made out for the benefit of a large class of chronic invalids whose sufferings are known, but whose causes of suffering are not known.

To Collect the Spirilina.—Take some of the morning sputum of old asthmatics, dry on a piece of white writing-paper, away from the stove or sun. A mass one inch in diameter is enough. The specimen will keep thus indefinitely if put in an envelope and stored in a dry place, away from insects or mice. By this mode of mounting asthmatic sputum can be sent in a letter around the earth. For examination this dried specimen is moistened with clear water and soaked until as fluid as when expectorated. Then a small portion of the sputum may be transferred to a slide by means of a wooden toothpick fresh and clean, which catches the slippery mucus, and which I have found to answer best in handling the slimy, sticky, and hard-to-manipulate sputum. Once used they are spoiled, and their extreme cheapness makes it easy to always use a new one. After covering so that the sputum is uniformly diffused between the slide and cover, the mount should be placed under a one-inch objective and one-inch ocular. This combination brings out the *S. asthma* better than any other power. To save time in clinical work, I use broken slides for covers. I find that more pressure can be exerted, with no danger of fracture, than with the ordinary thin covers. It should be added that my clinical one-quarter-inch Tolles has a working distance of about one-quarter inch.

The *Spirilina asthma* shows thus a peculiar lustrous, shining waved spiral or singularly twisted or recurved line, of length varying with the treatment it has had in its travel through the air-passages, and hence to and on the slide. As said before, it looks like a highly polished gold wire 18 carats fine. It is tough as a wire. Dr. Salisbury attributes the peculiar tenacity of asthmatic sputum to its fibre growing in the mucous follicles and offering a physical resistance to the withdrawal of the sputum by the outward motions of the cilia of the cylindrical epithelia of the respiratory tract.

It has a peculiar habit of engaging and surrounding itself with tenacious, gelatinous mucus in fibres or strings more or less

marked, which wind around it and which are more or less loaded with granular and sometimes massive gravel, made up of the triple phosphates of ammonia, lime and soda, uric acid, oxalate of lime, cystine and the other gravels which seem to be the same as found in the urine and feces, their normal and natural outlets, and which seem to have been clogged, and the gravel obliged to find exit by the mucous membranes of the respiratory tract. Sometimes these gravels are in an acicular form, sometimes in narrow rhomboids, sometimes in broad rhomboids terminated at both ends with one, two, three, and even four sharp points. The presence of these crystalline matters, with needle-points sharper and more accurately formed than the point of the finest needle, more or less irritates the circular muscular fibres of the bronchi, and renders them susceptible to spasmodic contraction which closes up the air tubes, already obstructed, and causes difficult breathing and what is known as an attack of asthma. Irritation of the nasal mucous membrane will produce a like but not so complete a contraction of the bronchi.

It would seem a sufficient explanation of the neurosis called asthma to say that if any outside part of the body were pricked with finest cambric needles twenty times a minute, year in and year out, the part would become so over sensitive—that is, “hyperæsthetic”—as to cringe at the very approach of said needles, and besides become convulsed with cramp from the involuntary contraction of the muscles of the part.

The *Spirilina asthma* does not add to the ease of expectoration, but adds to the suffering of the patient. The *Spirilina asthma* is removable. In my own case it seems to have gone of itself, though of course I cannot tell but there are more specimens in my air-passages. I have seen a species of the *Oscillariæ* healthily growing in the healthy spleen of a frog, and apparently harmless to the host.

I have called the attention of Prof. P. F. Reinsch, of Erlangen, Germany, to the *Spirilina asthma*, but with little satisfaction, as it seems to be nearly unknown in Europe, which gives all its attention to the baby vegetations, *i. e.*, *bacteria*, and cares but little for the adult forms of the same vegetations.

As full-grown botanical specimens are of more value for biological uses than their seeds alone, or as oaks are of much more importance than acorns alone, so in the future this *Spirilina asthma* will attract more attention than it now does. For one, I am grateful for the discovery of the *Spirilina asthma*, as it gives a better practical, clinical idea of the physical causes of asthma, hitherto deemed a neurosis with invisible causes.

POSTSCRIPT.—Extract from a letter of Prof. Paulus F. Reinsch, of Erlangen, Germany, to the writer, dated May 4, 1892: “The specimens of asthmatic sputum you sent over for examination last year I have had in examination, but I could not perceive the

transversal septa characteristic of the Oscillariæ, to which, I suppose, this parasite is claimed to belong. Therefore, I am inclined to claim for Spirulina a form near to Leptothrix, or to cells belonging to the mycelium of a hyphomycetous fungus. There is no doubt that these spiral, long, curved cells are of vegetable origin."

Trichinæ Spiralis.

By W. N. SHERMAN, M. D.,

MERCER, CAL.

A knowledge of the *Trichinæ spiralis*, and of the symptoms it produces in the human body, is very necessary to the physician, and public instruction concerning its character and habits would enable others to avoid it.

Instances of their presence in the human body are not uncommon, and they are often overlooked; the symptoms produced by them being mistaken for enteric fever or rheumatism. As it exists only in flesh-eating animals, we need have no fear of its existence in other food than meat, although it has been asserted that an infected carcass might pollute the water of a stream near by and reproduce the disease through drinking the water. This is not very probable, however. *Spiralis* is suggestive of its spiral shape, which is beautifully illustrated in figure 1,



FIG. 1.—Photomicrograph of *Trichinæ spiralis* magnified 75 times. From a cross-section of a section of human flesh.

showing the worm as it appears coiled within its capsule. Otherwise, this parasite worm is not unlike a common earth-worm, except in its microscopic dimensions. While they do not at all times assume so perfect a spiral shape as shown here, their tendency is to that shape; hence their name "*spiralis*."

In sections of infected meat it is frequently seen coiled within a protecting capsule (Fig. 1), which it occupies, in an inert condition, until a favorable opportunity occurs for reproduction and migration.

In its mature state the *trichinæ spiralis* is an extremely minute

parasite, the male, in its fully developed and sexually mature condition, measuring about $\frac{1}{18}$ th of an inch, while the perfectly developed females, which are ten times as numerous as the opposite sex, are over double that length. Their bodies are round and taper slightly from the middle toward each end. The head is narrow, finely pointed, unarmed, and with a central minute oral aperture. The mode of reproduction is viviparous. As usually found it is encased in its protecting capsule, which is about $\frac{1}{140}$ by $\frac{1}{120}$ th of an inch in diameter. These cysts or capsules are sometimes visible to the naked eye, as represented in Fig. 2, measuring $\frac{1}{100}$ th inch in width by $\frac{1}{60}$ th inch in length, while the worm itself, stretched out, is about $\frac{1}{28}$ th of an inch long by $\frac{1}{500}$ th of an inch wide at the middle of body.

The human eye is capable of separating lines $\frac{1}{200}$ th of an inch apart without the aid of a lens, so you may know that by transmitted light, and in thin sections of meat, these capsules may be readily observed. They appear like small round dots, granules, vesiculæ, or streaks, grayish white, and quite distinct from the red, transparent muscle. When numerous, they sometimes impart a specked appearance to the meat. They can be readily seen by the aid of the microscope under an amplification of 75 diameters, and are well illustrated (encapsulated) in Fig. 2, which is an isolated specimen chosen to show the characteristic appearance of the closed capsule. This is the form in which they usually exist in infected meat and are taken into the human stomach. When meat containing such encysted trichinæ is eaten, the action of the digestive fluids, being acid, dissolves or soft-



FIG. 2.—Human flesh magnified 75 diameters showing Trichinæ in capsule.

ens the capsules, which is of a calcareous or lime consistence, and the animal heat of the body animates the parasite to renewed exertion, so that it bursts the capsule (Fig. 3) and escapes into the intestinal canal, where it enters upon an active career, increasing in size and sexual activity.

About the second day after their introduction, the intestinal trichinæ attain their maturity, lose their spiral shape, and become stretched, while they grow rapidly in sexual activity. Most

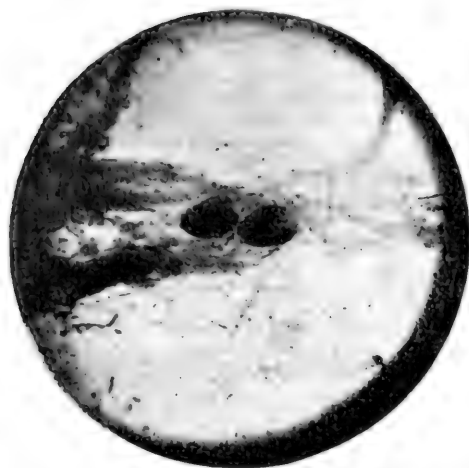


FIG. 3.—Section of flesh showing capsules broken and escape of *Trichinae*.

lodgment in the muscles of the body. They travel in the coarse intermuscular connective tissue, and their favorite seat is in the sheathed muscles nearest the cavities of the body, more particularly the diaphragm, near its attachments, and in the psoas, or loin muscles of the back. They sometimes invade, in much less numbers, all the muscles of the body, producing severe pain and stiffness of the infected parts of the body.



FIG. 4.—Showing section of trichinous meat.

females produce from 1,500 to 2,000 embryos, and as they are ten times as numerous as the males, their reproduction is rapid. In six days the females contain perfectly developed and free living embryos, and these pass out at the vaginal opening and are set free in the intestinal canal of their living host. Being born without any shell, free and active, they soon commence their wanderings, boring through the intestinal walls in seeking permanent

lodgment in the muscles of the body. They travel in the coarse intermuscular connective tissue, and their favorite seat is in the sheathed muscles nearest the cavities of the body, more particularly the diaphragm, near its attachments, and in the psoas, or loin muscles of the back. They sometimes invade, in much less numbers, all the muscles of the body, producing severe pain and stiffness of the infected parts of the body. In about 12 or 14 days after they have become permanently located in the muscular tissue they acquire the size and appearance of the *Trichina spiralis* (Fig. 1). The spot inhabited by the rolled-up parasites is converted into a spindle-shaped widening, and within this nest, under the thickened sarcolemma, the formation of the lemon-shaped cyst commences by peripheral hardening and calcification. One cyst may contain from one to three worms.

The worms become encysted and enter an inert state after

reaching their final resting-place in the muscles, and after a few months the cyst is formed around them, rendering them harmless to the person bearing them. In this encysted state they retain their vitality, it is said, for many years, and when the flesh of the animal is eaten by another they again produce their young and pass through the same cycle.

One authority briefly describes them thus: "The life-history of trichinæ is contained in a cycle, which includes at least two animals, the first being that in which the parasite is born, partly matured, and then enclosed in a living tomb, and the second, that in which it is set free and in which it becomes fully matured, propagates its species, and dies."

It is during the migratory stage that they produce their characteristic symptoms in the human subject. The symptoms begin a few days after eating the meat, with fever, loss of appetite, gastric irritation, and diarrhœa, and is often mistaken for enteric fever, while the violent muscular pains resemble rheumatism. These symptoms last from 4 to 8 days, varying in intensity according to the extent of the invasion.

Nothing is known as to the origin of this parasite. Hogs get them from eating rats, but rats do not seem to be the original source, for when hogs are absent rats contain few trichinæ. It has been said that 1 in 50 hogs contains trichinæ, and 1 in 10 rats is trichinous. This being the case, we might ask, why are cases of trichinosis so rare in a country where so much pork is eaten? For two reasons: first, the worm is killed by a moderate heat, 140° Fahrenheit, so that any ordinary cooking makes it safe to eat trichinous meat; second, all the large Eastern packing-houses employ persons to examine small pieces of the diaphragm of each hog killed, and those found trichinous are consigned to the soap vat. All cases of trichinosis in man arise from eating raw or smoked meats. Salting and smoking do not kill the worm, and salted or fresh pork should be well cooked.

The most frequent source of the disease is the so-called bologna, made from trimmings of the hog mixed with beef. The ham and shoulders are less apt to contain them than the sides.

Trichinæ may be easily detected by taking a small piece of the suspected meat and placing it between two glass slides and pressing it until the fibres are thoroughly separated, or by teasing it out with needles. A minute quantity of distilled water should be placed on the specimen before it is pressed out. For permanent microscopic mounts, the flesh must be cut into pieces about $\frac{1}{4}$ inch cubes and hardened in alcohol, then cut into thin sections and stained with carmine or picro-carmine, and mounted in Farrant's solution or balsam.

Another method described in one of the microscopical journals is said to be very good. Macerate a small piece of the trichinous muscle in cold water for one day, then tease it out with needles: place it between two glass slides and bind them together

with strong thread; immerse in 95 per cent. alcohol for ten minutes, then separate slides and transfer section to oil of cajeput; let it remain in the oil for two or three days, then mount in balsam. By this method the trichinae will not "disappear" as they sometimes do by other methods, nor will they shrink.

Fig. No. 1 is stained with picro-carminé, and is a most beautiful mount. The photomicrograph from which the illustration is made was taken by ordinary lamp-light and Carbutt's orthochromatic plate. The other preparations, as illustrated, are by the same method from unstained sections.

The writer would be glad to exchange "photos" of Fig. 1 for pieces of fresh or hardened trichinous meat.

The American Potato Rot or Blight.

By JOSEPH F. JAMES,

U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

The potato plant has probably been subject to the attacks of fungi as long as it has existed. Under the bark of trees living during the time our coal was forming, there have been found fossils so similar to living examples of potato fungi, as to induce the belief that they were the ancestors of modern species.

It is a well-known fact that when a plant is removed from its native habitat and subjected to a diversity of conditions, and more especially when extensively cultivated, there appear upon it parasites, before unnoticed, that with increased cultivation multiply and spread with wonderful rapidity. So well known is this that it has sometimes been suggested that in order to develop a pest to destroy a pernicious plant it would be wise to cultivate the plant, and before long it would be attacked by numerous enemies, and its numbers thus lessened. It is scarcely probable that any actually new species of insect or plant enemies are developed in the process of cultivation, but having a more extended field in which to work they multiply in undue proportion, so that they kill the host upon which they feed. Thus it has happened that, although the potato was introduced from the New World into Europe shortly after the discovery of America, the destructive disease of the tuber did not attract any great attention until about 1830. Some sort of disease was noticed some ten or fifteen years before, but it was not until 1844 that the matter was inquired into by scientific men.

In 1846 it was shown conclusively by Berkeley that the disease was caused by a fungus, now well known as *Phytophthora* (*Pero-nospora*) *infestans*. Since then exhaustive studies have been made of the parasite, and now, not only is its life-history well-known, but means for its prevention have been discovered.

The disease commonly spoken of as potato blight, in this country, is caused by two distinct species of fungi. One of these is the *Phytophthora*, already referred to, and which is the blight of

European countries. The other cause is *Macrosporium solani*, and this, in the United States, is more prevalent than the other. The general outward appearance of the two is the same, and only by a microscopical examination can they be separated. As, however, the effects of both are alike, and as the treatments for prevention are identical, a description of the one will apply to the other. Both are more prevalent on late than on early potatoes, and warm, moist weather is that during which they grow and spread with greatest rapidity. Both seem to appear suddenly and run their course rapidly. The following remarks, while applying more particularly to the *Phytophthora*, will generally hold good



FIG. 1. Potato leaf affected by blight.

for the other fungus. The sudden appearance and spread of the *Phytophthora* has been frequently observed, and as long ago as 1845 was commented upon. A twenty-acre field that on one day in the last week of August was green and thrifty, on the following day looked "as if it had been exposed during the night to the action of steam. Stems and leaves were soft and blackened; in six and thirty hours a few sickly stems and discolored leaves were all that remained. The crop had ceased to exist." This fungus has been found not to grow and produce spores at a lower temperature than 34° , or a higher one than 77° . The best temperature for it is 72° Fahrenheit.

Generally the first noticeable effect of the disease is a brown or black discoloration of the leaves (Fig. 1), those nearest the ground being affected first. There soon appears, however, on the under surface of the leaves, a whitish down, which spreads rapidly to the stem, and soon affects the whole plant. Under the microscope the leaf fungus appears as shown in Fig. 2. The minute spores develop in great numbers and fall to the ground, whence they are

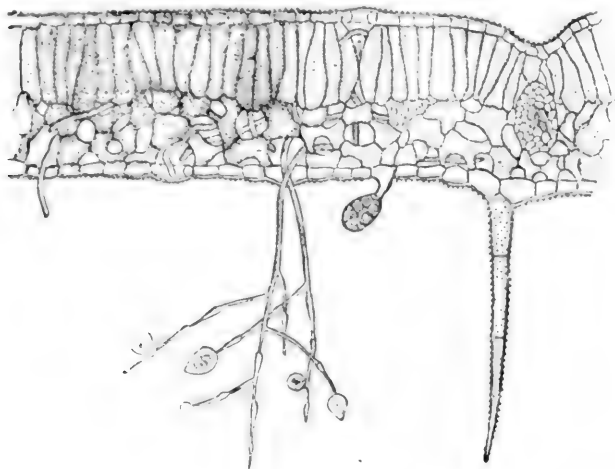


FIG. 2. Manner of growth of the phytophthora.

washed into the soil by rains and thus affect the forming tubers. The spores are also carried long distances by the wind, and from one field others for miles around may be affected. The development and growth of *Macrosporium* is similar to that above given.

The remedy is to be found in spraying with the Bordeaux mixture.—*American Agriculturist*.

Exhibits at the Chicago Exposition.—1.

W. Watson & Sons, 313 High Holborn, London, and 78 Swanston street, Melbourne, Australia, are exhibiting in the British Section specimens of the scientific instruments for which they have a world-wide fame, and have sent out from London one of their regular staff who is conversant with the practical manipulation and will consequently be able to explain the instruments in a far better manner than a catalogue will do. The principal features of their exhibit are photographic cameras, lenses, and accessories, microscopes and accessories, stereopticons, surveying instruments, etc.

Cameras.—The aim has been to get the lightest and most compact form possible, consistent with strength sufficient to withstand travelling and climatic variations. This is realized in the highest degree in their Acme camera, which they are making in the American sizes. By the adaptation of aluminium for the fittings in substitution for brass, weight has been further greatly reduced. Aluminium has been considerably improved of late years by alloying with other metals, and it is now thoroughly reliable and will stand hard usage; its weight-saving advantages can be easily appreciated. They are also showing a hand camera, called the Vanneck, which has the great advantage over any other of enabling the user to see the subject photographed during the whole time of exposure, by means of an extra focusing screen, let in from the top of the camera. It is exceedingly compact and can be used either with the ordinary dry plates or roller films; the neatness of its get up, also, is so unobtrusive that it is not likely to attract attention as some more palpable hand cameras very often do. Their photographic lenses are made in every size and of every type specially for portraiture, landscape, architecture, instantaneous work, etc. These also are shown both in aluminium and in brass. It may not be generally known that within a very recent period it has been possible to have photographic lenses certified as to their qualities at Kew Observatory. Watches, thermometers, etc., have long been examined there, and it will be a great satisfaction to purchasers of photographic lenses to be absolutely sure from an independent verification like this that their lenses are faultless. Should any one desire to have them verified, Watson & Sons supply certified lenses to their customers and will exhibit certificated lenses at the Exhibition.

Microscopes.—These instruments are used for a variety of purposes consequently there is a variety of models. For photography they are exhibiting their Van Heurck microscope, which is of exceedingly complete design and rigid construction. For student's use their Edinburgh Student's microscope, which has been supplied to universities and medical colleges throughout the world, can be taken as a good example; also special instruments for amateurs who take up the microscope for recreative reasons, petrological microscopes for mining engineers, etc., etc. In these, also, aluminium plays a part wherever practicable.

Transit theodolites and levels of the latest and most approved construction, combining every possible convenience for surveying purposes; also stereopticons, both singles and biennials, of the most recent designs are exhibited.

We may mention that this firm has already been awarded 32 gold and other medals at different Exhibitions of the world, including Paris Exhibition, 1889, two gold medals; Kimberly Exhibition, South Africa, 1892; Melbourne Centennial Exhibition, 1888; also at Exhibitions in London, Glasgow, Antwerp, Adelaide, Calcutta, Amsterdam, etc., and 9 times they have been placed alone at Exhibitions, receiving a higher award than any other exhibitors showing similar goods.

Crenation of Red Blood-Corpuscles.

By M. L. HOLBROOK, M. D.,

NEW YORK

The crenation, or formation of notches along the borders of the red blood-corpuscles soon after they have been put on the slide for the microscope has been observed by all who have studied the blood even cursorily. I have made observations of this feature of the corpuscles in a large number of cases and have observed the following facts:

The crenations are most numerous and form the most quickly in persons in good health and with a vigorous constitution and when the color is of a pronounced red.

In a chlorotic girl, with a rather poor constitution, it was several hours before any crenated, and then only a few. In her case the blood was very pale. When she had improved in health the crenations were more numerous and appeared quickly after the specimen was placed under the microscope. In a very delicate child scarcely any crenated, even after a long time. It has been claimed by some microscopists that alcoholic drinks are a cause of it. I made special note on this point and found just the reverse; that in abstainers from alcohol, if the constitution is good, crenation takes place soon. In one case, nearly all were crenated within a few moments, except in that part of the field where they were crowded together so as to press on each other very closely. If the droplet of blood is put upon a slide with an oil frame around it to prevent evaporation, in most cases the crenations disappear after 72 hours.

The late Dr. Elsberg, who studied the corpuscles treated with bichromate of potash and made the discovery that each one has a reticular structure, claimed that the crenation was due to a contraction of this reticulum. I have no doubt of the correctness of his conclusion, and this will, I think, explain the reason for more vigorous and general crenation in cases of a good constitution than where it is very poor. There is more living matter in such cases and more power to contract. It would also explain why the crenations generally disappear after a few days. The living matter dies and loses its contractile power when the corpuscles swell out by taking in the fluid in which they are immersed.

The hæmatoblasts in the blood never become crenated, but I have in one specimen of blood seen a few with delicate thorn-like projections from their margins. This was in the case of a man about 60 years old and somewhat broken down in health. In his case the hæmatoblasts were abnormally numerous, amounting, on a rough estimate, to about one-fourth as many as of red blood-corpuscles.

Microscopical Study of Ohio Limestone.

By G. PERRY GRIMSLEY.

COLUMBUS, OHIO.

[Abstracted from Journal of Cincinnati Society of Natural History,
vol. xv, pp. 160-167.]

The year 1850 may be said to mark the beginning of modern petrography, when Mr. H. C. Sorby, of England, applied the microscope to the examination of thin rock sections. American students brought the science across the water, and now we have the names of Williams, Iddings, Cross, Wadsworth, Adams, and others connected with the science.

Lower Silurian Series.—The remnants of the old Silurian or Ordovician sea in Ohio occupy about a dozen counties in the southwestern corner of the State. The beds are highly fossiliferous, containing large numbers of brachiopods, lamellibranchs, trilobites and crinoids, so that the region forms the best collecting ground in the State for the paleontologist.

Selecting carefully a dozen slides, and examining them under the microscope, we find revealed to the eye monticuliporoids, with the species *mammulata* and *ramosa* especially abundant; the Trenton tentaculite; the spiny head-shield of *acidaspis*; crinoid joints very numerous, and with these fragments of shells, with their characteristic structure; of these only one was perfect enough for identification—the small *Cyclora minuta*. Numerous crystals of calcite or dolomite occur, showing the characteristic rhombohedral cleavage. It is impossible to separate these two minerals under the microscope, but, as this is a magnesian limestone, the crystals might be termed dolomite. A very fine section of *Ptilodictya fenestelliformis* was observed, which did not appear before the grinding, thus showing the utility of microscopic examination of rocks.

The predominant structure consists of shells and coral remains, either entire or broken. These shell fragments, though too small for identification, are yet useful to show the minute shell structure, appearing under a low power as mere dots, but under a high power they are resolved into obscure wavy lines and circles.

Clinton Group.—A narrow fringe forming the boundary between the lower Silurian and Niagara formations. The formation is of small extent, and in composition is almost a pure carbonate of lime. The limestone is distinctly fossiliferous, consisting of brachiopods, corals, and crinoids. Thin sections show many fragments of *Clathropora*, probably the *clintonensis*, a few fragments of Favosites, with other corals and a few shells. One layer of a light brown color, probably colored by iron, is quite compact, semi-crystalline, and only sparingly fossiliferous. Another form of the rock is of a light color, crystalline, and made up almost entirely of fragments of crinoids, being a typical cri-

noidal limestone. The crystals making up the remainder of the rock are calcite. Almost all of the sections contain some fragments of crinoids, and this was an age of crinoids, in distinction from the lower group.

Niagara Series.—Consisting of shales and a magnesian limestone, with considerable fossil life, which is mainly preserved in the form of internal casts, the characteristic forms being *Pentamerus*, *Trimerella*, *Monomerella*, and *Atrypa*. This marks the second great limestone formation in the scale, and doubtless was deposited in the Niagara sea as a pure carbonate of lime, but, by a slow dolomitic replacement, was changed into a fairly pure dolomite, and now is used quite extensively as a source of magnesian lime. From these facts it will be seen that a microscopical study will not be as satisfactory as heretofore, for but little original fossil matter is left. The dolomite crystals are very apt to break out in the process of grinding, thus leaving open irregular spaces through the section.

Lower Helderberg Formation.—or waterlime group of Ohio, which consists of a magnesian limestone, inclosing at a number of points large beds of rock salt and gypsum. This formation covers two dozen counties of the State, and the limestone contains a notable percentage of bituminous matter, appearing in streaks through the rock, which accounts for the odor of petroleum when it is struck with the hammer. It has long been regarded unfossiliferous, with the exception of a few casts, the most common being the small coffee-grain fossil, *Lepidoditthis alta*. In 1880 some blocks of this limestone were polished for the National Museum, and it was stated that "one polished upon the surface parallel to the plane of stratification showed a fossil bryozoan, and thus proved that it was fossiliferous." We are forced to say that the Helderberg limestone of Ohio is very sparingly fossiliferous, even in microscopic sections, but we cannot say the Helderberg sea in Ohio was without life.

Devonian, or Coniferous.—Extends as a narrow strip, 8–20 miles in width, through the central portion of the State. The limestone is quite a pure carbonate, abundantly fossiliferous, containing brachiopods and reef-building corals in great abundance. It is here that we find the first abundant plant and fish life preserved.

At Columbus probably the best development is to be found. The upper portion is shaly, with very few fossils, and these are mainly fish remains; below this stratum comes a brown and white chert, which is not acted upon by acids. The fossils in this chert are very finely preserved, even the delicate markings coming distinctly to view. Below this comes the bone bed, a comparatively thin layer made up of the teeth and remains of fish, while below this lies the great mass of limestone used for lime and building purposes. The microscope reveals many interesting and puzzling fossil forms.

The brown chert is very compact, but contains a few fragments of shells, crinoid joints, and a number of light spaces, highly crystalline, whose origin is to be traced to the replacement of organic life by crystalline matter.

The white chert is more abundantly fossiliferous even to the naked eye, but under the microscope it is one mass of fossil life, crinoid stems being especially numerous. There are a number of forms belonging to the group Porifera, or the order of sponges, sponge spicules being found through the rock.

Among all the sections there can be traced a great similarity. The limestone, under the microscope, is seen to be quite uniform, and confirms the observation made in the quarries that the abundant and predominant forms are brachiopod shells. One section showed the fossil *Styliola*, a pteropod shell, which often forms whole masses of Devonian limestone, but is very rare in Ohio Devonian.

The study of the carboniferous limestone is as yet incomplete, but a number of new facts are coming to light, and certain limestones long regarded as unfossiliferous are found to contain a variety of fossil forms, only revealed by the microscope.

The Tariff on Microscopical Books.

BY CHAS. W. SMILEY,

WASHINGTON, D. C.

The effect of the tariff on books may be well understood from the following prices of microscopical books published in England. We give the retail prices asked by Messrs. Watson & Son, of London, and the prices asked for the same books by one or more American firms:

	<i>Europe.</i>	<i>America.</i>
Beale--How to Work with the Microscope. .	\$5 25	\$7 50
Cooke—1,000 Objects for the Microscope, .	25	50
Davies—Mounting and Preparing Objects, .	37	1 00
Griffith & Henfry—Micrographic Dictionary, .	13 12	20 00
Hogg—The Microscope,	1 88	3 00
Slack—Marvels of Pond Life,	88	1 50
Wood—Common Objects for the Microscope, .	25	75
Total,	\$22 00	\$34 25

This shows an average increase in price of 65 per cent. The duty is only 25 per cent., but there are express charges, custom-

house fees, commissions, insurance, exchange, and some other small items which necessitate an advance in price. Of the books contained in the above list, there is not an American edition of one. The tariff and the dealers, therefore, in each case, inflict the higher price upon the purchasers and prevent many other people from buying at all, while at the same time they benefit not one American printer or binder. The dealer is benefited even to a less extent than he would be if the trade were unrestricted.

Now turn the picture. We publish a few microscopical books in America—such as, for example—

Dolley—Technology of Bacteria, \$2.00.

Lee—Vademecum of the Microscope, \$4.00.

MacDonald—Examination of Water, \$2.75.

Stokes—Microscopy for Beginners, \$1.50.

Stowell—Microscopical Diagnosis, \$3.00.

The above are the American prices. I do not find the books listed at all in the catalogues of London dealers. What would be the use to do so? Europeans will not pay such prices plus the cost of transportation, insurance, commission, brokerage, etc., when they can buy certain other books of home production that cover the ground pretty well at a quarter or half the cost.

In order to induce them to buy, the American publishers offer to sell to London dealers at lower prices than they sell for to their own countrymen. That, however, stimulates but very little trade.

On the other hand, Americans, in spite of the tariff and of the 65% advance in price, do buy a good many of the English books. Moreover, every traveller coming home brings his trunks packed with books as well as with clothes, tools, etc. Of course he does not carry such articles with him when going abroad. Now what is the net result?

Prices are high in America. We can buy foreign goods, pay the duty and still they cost only about the same as home products. Prices are low in England. Even though we sell to foreigners for less than we sell at home, and even though they pay no duty, they still cannot afford to buy from us: they can do better at home. Hence, the United States is now importing more than it exports. During the past three months (January, February, March) we have imported \$62,000,000 worth of goods more than we have exported, although one year previously during the same months we exported more than our imports amounted to.

We want every reader of this periodical to at once send us his opinion on this question of book tariff. If you are in favor of it say why; if not, say so and why. Later on we shall publish the returns.

Finally, if you will have foreign books you can often order direct from London much cheaper than to buy them of our own dealers. But every time you do it you help to swell the balance of trade, which is already terribly against us.

A Device to take the Place of the Camera Lucida in Micrography.

By HENRY G. PIFFARD, M. D.,

NEW YORK.

The art of micrography, or the reproduction on paper of images of minute objects seen through the microscope, may be practised in various ways, of which the three following are the principal :

1. The observer studies the object on the slide, and when he thinks he has the outlines and details or a portion of them sufficiently impressed on his mind, withdraws his eyes from the tube and commits the mental picture to paper, using, of course, both eyes in directing the movements of his pencil. Success with this presupposes a very retentive memory and considerable skill as a draughtsman.

2. The observer, looking down the tube in the usual way with one eye (for convenience the left), is, after a little practice, enabled, by a sort of autoprojection, to see an image of the object on a sheet of paper by the side of the microscope. The outlines of this image he traces with the pencil, using the right eye to direct its movements, the observation and the reproduction being simultaneous.

3. By the aid of a camera lucida, of which there are many different sorts, a reflected or projected image is visible on the paper with the eye that is at the same time occupied in directly observing the magnified image of the object on the stage. In one of the latest forms of camera lucida—the Abbe—this use of half the eye for observing and the other half for recording is a reasonably convenient method, if the observer's eye is approximately normal; marked myopia or hypermetropia, and still more pronounced astigmatism, necessitating the use of spectacles, render the use of the camera lucida inconvenient, if not well nigh impossible.

Some time since, it occurred to the writer that the practice of micrography could be greatly simplified by adopting the principles employed in ordinary projection, as used in connection with the optical lantern, the projection microscope, photography, etc. It was only a question of reflecting the projected image onto a piece of drawing-paper fixed in some convenient position. To this end, I requested Bausch and Lomb to mount a right-angled reflecting prism with a short tube extending from one of its square faces, this tube to be of such calibre that it could be inserted into the microscope in the place of the eyepiece. From the other square face a similar short tube extends, capable of receiving the ocular and holding it firmly.

When preparing to use this device the object is placed on the stage, and focused in the usual manner. The microscope is then brought to a horizontal position, the eyepiece is removed, and

the prism case put in its place, the ocular being inserted in the short tube provided for its reception. The ocular should point downward. The lamp or other source of light should then be disposed in such a way that it properly illuminates the object to be examined, it being expressly understood that no light shall escape toward the observer except that which first reaches the object. A Beck lamp is conveniently adapted to this purpose. If a piece of drawing-paper is placed beneath the ocular, and the room darkened, a brilliant image will be projected on the paper, and its reproduction can be easily accomplished with a maximum of rapidity and a minimum of discomfort. In guiding the pencil the draughtsman uses both eyes, and his spectacles if needed, and sits in whatever position he finds most comfortable. With a proper lamp, and careful utilization of its light, this device gives excellent results, with amplification up to four or five hundred diameters. If a sensitive photographic plate be substituted for the drawing-paper, an exposure of a few seconds will impress an image that may be developed in the usual way.—*New York Medical Journal*.

Spiral Vessels of Castor-Oil Plant.

From Note-book L of the American Postal Microscopical Club.

By R. H. WARD, M. D.,

TROY, N. Y.

For the study of this specimen use only powers of 2 in. to 4-10ths in., or for the special purpose mentioned hereafter a low-angled 1-5th or 1-6th; as the contour of the spirals shows best with objectives of greatest available depth of field, and higher powers are unnecessary. Most satisfactory stereoscopic views can be got with the Wenham binocular and a 1-2 to 4-10ths objective, with special illuminating arrangement for working the binocular at its best with medium or higher powers—by means of a horizontal-slit diaphragm combined with a substage condenser, as introduced by the writer at the Am. Ass'n for the Adv. of Sci. in 1870 (see *Am. Nat.*, 1870, pp. 635-8) and used with satisfaction ever since that time. * * *

This specimen, by the remarkable compactness of its spirals, suggests its probable origin near the outside of an already formed portion of the plant, as those which are formed in the bundles around the pith of a rapidly growing shoot commonly have the convolutions spread into an open spiral by the elongation meanwhile occurring in the tissues. This plant (*Ricinus communis*) has long ago been noticed as furnishing "very striking examples" (Sachs) of these spirals in the stalk (*rachis*) of its flowers.

The slide presents a field for a little practice in microscopical mechanics of the easier sort. The cylinders of coiled fibres which line the ducts are formed, in various plants, of single fibres

or bands of from two to twenty parallel fibres. After a moment's study with a $\frac{1}{2}$ in. of a mount like this, where the coils are drawn out and more or less "uncoiled" into bands, every intelligent observer will know the number of fibres in each band in the tangle, which, over the greater portion of the field, cannot but be seen. But take a section with the spirals *in situ* and undisturbed, or if using a teased-out specimen like this take the first view with the 1-5th obj., find at once a still closely coiled cylinder, include in the field only that portion which is quite symmetrical and which shows no hint of splitting into bands, or if that be seen, disregard it entirely, and set out to determine the number of fibres wholly by their slant or pitch in the coil; and not as a clever guess, but as an absolute fact which nothing could make you doubt. Any child can distinguish a 2-thread screw from a 9-thread one; but to decide thus between one of these close spirals as formed of 5 or 6 threads is next to impossible without special instrumental appliances, and even with them is far from as easy as it appears, on account of the curvature of the lines, the constant change of plane, and the lack of absolute mechanical regularity. The simplest available aid in this case would be a cover-glass dropped into the position of an ocular micrometer, in the focus of the eye-lens, marked with a straight scratch with a writing diamond, or with a fine line of India-ink across the centre, to be set exactly transversely as a straight-edge across the coil. A much better aid to the eye is the common ruled ocular micrometer with its parallel lines, and often with a transverse line or edge at right angles to them; though an awkward want of conformity in the spacing of the lines can only be avoided by using a large variety of rulings or of objectives, or by resorting to inconvenient lengths of draw-tube. By far the best aid of all is the cobweb micrometer, whose pair of parallel threads can be readily set to exactly take in any desired number of the slanting convolutions.

Dust at Sea 200 Miles from Coast of Africa.

From Note-book Q of the American Postal Microscopical Club.

By R. H. WARD, M. D.,

TROY, N. Y.

This interesting specimen of ocean dust might almost be called a "fossil earth," being so full of broken diatoms and other micro-organisms which can be easily recognized with a 1-5th obj. It may well have been whirled up, along with more or less of coarse sand, from some dry spot on the African coast, drifted along in the higher levels of air, separated gradually from the coarser particles by their earlier subsidence, and at last precipitated quietly, during those calm, cool, moist days, in a typical "infusorial shower," such as has been occasionally observed since the days of Ehrenberg.

Neither the distance of 200 miles from the coast nor of 700

miles from the desert source suggested by Dr. S. is excessive, as it is well known that such light dust floats to much greater distances. At the time of the Krakatoa eruption, a remarkable example, only ten years ago, its dust darkened the air for ships that were not within sight of the mountain, burying their decks inches deep in dirt; it whitened the decks of vessels more than 1,000 miles away, and it was noticed and identified at a distance of from three to four thousand miles. And it will be remembered that Ehrenberg believed, whether prudently or not, that he recognized organisms from Africa in the air of Berlin, and from America in the air of Portugal, the former, presumably, having made an aerial voyage across the Mediterranean sea and the European continent, and the latter across one of the widest stretches of the Atlantic ocean.

This specimen does not seem to present the familiar characteristics of volcanic dust—glassy, crystalline particles of angular fracture and containing minute, and often elongated, bubbles from gases that were imprisoned in the fluid mass; nor the beaded forms and drawn-out vitreous threads suggestive of artificial furnaces and neighboring chimneys. Nor would such structures be expected to be found in connection with these numerous and well-preserved organic remains.

The well-known power of fine dust-particles to precipitate atmospheric moisture around them, and form a fog or haze, is doubtless illustrated in the three days' fog in which this dust was collected.

The most puzzling feature of the mount is the large quantity of cotton and other fibres. Considering the amount of this and the character of the collector, the most common source of such admixture—contamination by carelessness while preparing the mount—may be left quite out of the question. And, for the same reason, it may be considered as improbable as it could be in any case, that the collection itself was of a mixed character. Doubtless it was as pure as could be obtained on the ship at that time. Yet the writer finds it impossible to believe, on the present evidence, that the fibres were a part of the original dust—a conclusion extremely improbable and incompatible with what has been observed during his many years of interest in this study of atmospheric dust. It is nearly incredible that textile fibres existed in any such proportion along with the vast quantity of mineral dust that furnished the original supply; and if they did, they differ from the rest so completely in size, form, density and physical character generally that they would be very unequally affected by the buoyancy of the air and by the drifting power of the ever-varying wind, and they could never have kept company with the finer particles during an aerial voyage of hundreds of miles. It is much easier, and in fact inevitable, to conclude that they belonged to the local dust of the ship itself, which by some unsuspected means, as for instance by the flapping of the sails, had become mixed with the "infusorial earth" from Africa.

Note on Collar Correction.

By S. G. SHANKS, M. D.,

ALBANY, N. Y.

There is a certain but not a short cut to the art of managing a correction collar. Unfortunately, no simple rules can be formulated that will fit all objectives, objects, and eyes, but, as in every other sort of high-class work, the capable and willing can and do surmount the difficulties and enjoy fine definition, while the lazy one is waiting for the short cut to come to him. Every owner of a good objective should also own a Möller test-plate or a series of mounted diatoms of increasing difficulty of resolution. These test objects are among the easiest to master, and attentive practice over them, until the markings within the capacity of the objective are resolved, will teach any one the value and general method of using the collar. The following facts will be of assistance to the student:

The zero point of most objectives indicates the open point, *i. e.*, where the lens systems are most widely separated, and this is the position of best correction for uncovered objects. A thin cover or short tube requires the collar index near zero, *i. e.*, the open point. A thick cover or an object low down in the balsam or a long tube requires the collar moved somewhat away from zero, *i. e.*, the systems nearer the closed point.

Correcting by coma.—Find a small speck of dirt in the mount, at about the level of the object, focus up and down, noticing the hazy edge or coma surrounding the speck when out of focus. If this is wider when the objective is above the focal point, turn the collar toward zero. If the coma is wider when the objective is lowered below the sharp focal point, turn the collar away from zero. Adjust until the coma is uniform within and without the focal point.

Correcting by color.—Find a speck of dirt as above, focus sharply. If the edge of the speck shows a yellowish tinge or halo, turn the collar away from zero. If the edge shows a bluish tinge, turn the collar toward zero. When correct the high points or corners of the speck should be ruby red and the lower edge show a fine apple-green halo, narrow but distinct.

Correcting by coma and by color as above are useful when the elements of the object are very delicate and have no well-defined edges or markings. Diatoms or fibres are the easiest for practice and may be used directly. A diatom under a well-corrected objective (not an apochromatic) will appear flat and crisp, the high parts, edges or midrib, will be tinged with a beautiful ruby-red color, and the shadows will have a delicate, apple-green tint. The majority of objectives being slightly undercorrected for color, will exhibit these tints when at the point of best correction.

Neither coma nor color will be distinctly seen at first by the novice, but after some practice they will become plain enough.

The writer finds correcting by coma very puzzling; small differences in the coma are not easy to perceive. Correction by color is much the easier method, and is the one habitually employed.

These hints may be of service: In using histological mounts, select a cell with nucleoli within the nucleus. When best correction is obtained these nucleoli will appear as sharp and well-separated grains. The fainter elements will then appear. In blood mounts, select the narrow line of space between several contiguous corpuscles, correct until this line is perfectly sharp. With bacilli, correct the same as on the blood.

EDITORIAL.

Second-class Matter.—The U. S. Government, with a liberality exceeding that of all other governments, permits us to send out our issues upon payment of one cent per pound postage. But circulars and advertising matter cost from 16 cents per pound upward, according to the size of each package. Hence, people whose primary motive is to advertise often put in a little reading matter and try to smuggle the compound through at second-class rates. They thus would cheat the Government and at times discredit honest journalism. There is a periodical in New York known as *Printer's Ink*, which inserts as much or more "reading matter" than advertisements, but the P. O. Department has refused it admission at second-class rates. Last year it paid \$32,000 more for postage at third-class rates than it would have had to pay on the same issues had they been admitted at second-class. Its "reading matter" is as interesting to us as that in the average of exchanges that come to us at second-class rates. And yet we believe that almost every article of "reading matter" in every issue is paid for by some concern wishing to advertise its goods. We will risk this declaration: If the publisher prints such matter, which is unquestionably very valuable to certain trade people, *without* exacting pay for so doing, he is not very sharp and is not improving his opportunity. If he pays \$32,000 postage at third-class rates each year for the privilege of sending out such articles free of charge he would seem to be losing money largely. But we do not think this to be the case.

Now, as to matters microscopical. There is a periodical, the bi-monthly issues of which consist of 8 pages of text—48 pages per year, and from 6 to 8 pages of advertisements in every issue. But the advertisements are nearly or quite all advertisements of the goods of the publisher. The reading matter is very rarely original and is clipped from *Times & Register*, *Jour. R. M. S.*, *Annals of Hygiene*, *Observer*, "*Ex.*" *Therapeutic Review*, etc. At one time it clipped from our columns altogether too

liberally. The primary object of its publication undoubtedly is advertising, and were the department as strict with it as with *Printer's Ink*, its admission at second-class rates would probably cease. But not wishing to seem ungenerous towards what somebody might possibly dream was a rival of ours, we have never before alluded to the subject. We do it now only in order to explain a little pleasantry which we quote from its columns. Our friends will doubtless share our mirth in reading it.

“H. M. W.— has handed us a carefully prepared index to vol. ix of the — (1892). Owing to an unexpected delay in getting out the December number we were not able to publish it at that time, and to do so now would greatly increase the expense, not only of printing but of sending out this issue, as it could only go at third-class rates. As the whole ‘volume’ is so ‘microscopic’ in size, and hence articles are easily found therein, we hope our readers will excuse us in the matter.”

Now as they were “not able” to publish the index which H. M. W. had so unwittingly prepared, we will offer to edit and publish it for him for the sum of \$10. and will guarantee that if the periodical in question is rightfully entitled to go through the mails at all at second-class rate, the index will go too, in any issue in which one cares to send it.

We have seen copies of the said periodical which had passed through the mails at second-class rates inside of which were folded loose circulars having no connection with the issue containing them—the clearest possible violation of the law—and yet we are told that a belated index would subject the issue to third-class rates! Let us laugh.

LETTERS TO THE EDITOR.

NOTE.—*This column is open to all correspondents who write upon the topics enumerated under “Problems,” or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.*

(29) Terrace Dust.—Referring to “Problem” No. 7, page 86 of your March issue, I would suggest that the magnetic spherules thought to be of cosmic origin might be only cinder-dust, blown to housetops by the wind or escaping from chimneys with the smoke. Such particles would necessarily be fused and be of about the composition indicated in the article on “Terrace Dust.” I have obtained such magnetic particles as illustrated in the *above* article from the sediment found in cisterns in the following way: A horseshoe magnet was covered with muslin, then fastened to a pole and dragged over the bottom of the cistern. Magnetic par-

ticles were thus caught in the meshes of the muslin, from which they were afterwards easily washed by shaking the cloth in a shallow dish of water. The bare magnet was then moved about in the dish of water, and the particles thus collected transferred to a glass slip and mounted. A comparison with similar particles obtained from coal-ashes presented scarcely any difference.

In this connection it may be of interest to add that I have examined hail but failed to find magnetic particles, though the dust found in the hail was considerable. Has anybody ever gathered such magnetic spherules from hail?

E. B. KNERR.

ATCHISON, KANSAS, *April 24, 1893.*

(300) **Criticism of Wethered's Medical Microscopy.**—On page 153 Wethered states that fresh material frozen and sectioned can be used for temporary examination, but that if you want permanent mounts the material must be hardened, embedded and sectioned.

But I have many sections that were never hardened nor embedded, which, though mounted years ago, are as good as they ever were. They were frozen and sectioned with Cathcart's microtome, then stained and mounted without having been sectioned, hardened or embedded. The beautiful sections of Arthur Cole are made by freezing with Cathcart's microtome and without embedding.

On page 321 Wethered says that the red corpuscles are 1-3200th inch in diameter, but he should have added that they vary in size both above and below that figure.

P. C. C.

MICROSCOPICAL APPARATUS.

A Cheap Microscope Illuminator.—Take any flat-wick lamp with a good burner and a clear, clean chimney. Light the lamp, put on the chimney, turn up the wick a little, and with a card check the draught by partly covering the opening at the upper end of the chimney. This will smoke the inside of the chimney and make it impervious to light; or light the lamp without the chimney, turn up the wick until it smokes freely, and smoke the inside of the chimney until it will not show any light through the blackened surface; allow the chimney to cool, and with a piece of paper remove the soot from a small part of the inside opposite the brightest part of the flame. The clear spot can be placed towards the edge or side of the flame as wanted.

PROVIDENCE, R. I.

N. N. MASON.

The Acme Lamp and Attachments.—The lamp consists of a heavy base with upright, carrying a claw-shaped holder, adjustable vertically and also turning on a horizontal axis. This claw-

shaped holder in turn carries the oil reservoir, and attached to this is the shade carrying the bull's-eye lens. This is a finely ground and polished lens, which, being accurately focused upon



The Acme Microscope Lamp

a flame of moderate size, gives a light sufficient for the highest powers, with very little heat.

For whitening this light there is a disc of blue-tinted glass, D, which is held back of the bull's-eye lens by a small ring; and for softening the light, when used with low power, a ground glass,

E, which slides over the projecting tube which holds the bull's-eye lens.

There is sometimes use for an extra shade, A; this slides inside the main shade and entirely cuts off all reflection from the eyes. The latest production is a sand-bath attachment, which consists of a ring, B, adjustable on the main upright, and a pan, C, for holding the sand. This can be used for all purposes to which the ordinary sand-bath is adapted, as for warming slides in preparing or hardening balsam mounts. The apparatus is very compact, and when packed in its case occupies but a space of 4 in. x 4½ in. x 9 in., thus adapting it for the microscopist who needs a portable lamp.

The price of the lamp is \$5.25, extra shade 25 cents, sand-bath 75 cents, blue glass 25 cents, ground glass 50 cents: total \$7.00.

The Star Microscope.—Messrs. Williams, Brown & Earle, of Philadelphia, recommended their Star Microscope, which has fine and coarse adjustments, 1-inch eyepiece, 1-inch objective, a double mirror and diaphragm; and sells at \$20. The same stand fitted with an additional objective (¼-inch) costs \$27.50. This instrument is made by R. & J. Beck, of London, and pays a duty of 40 per cent. It nevertheless sells at about the same price as domestic instruments of the same grade. The objective and eyepiece are the same as furnished with higher grade instruments. To the substage can be fitted all ordinary accessories, like condenser, polariscope, and illuminator. The base is filled with lead and the stand not likely to be overturned by accident. Great delicacy of focusing is claimed for this instrument, and its fine adjustment doubtless makes it somewhat superior to all which lack a fine adjustment.

MICROSCOPICAL MANIPULATION.

Micrographic Projection.—It has been said, in reference to the necessary absence of "depth of definition" in the microscope, that more perfect impressions of objects in relief may be obtained by rocking the microscope tube to and fro. It is, however, by no means an easy method of building up a correct mental image of the magnified object. Naturally the suggestion presents itself that visual persistence might be made useful. But to give the object or the lenses a reciprocating motion of the necessary frequency would appear to be an almost absurdly impractical device. In a scientific toy which has been recently described, it is claimed that the property of persistence of vision has been usefully applied. But in this instrument, which is a projecting microscope, it is the screen that is made to reciprocate in the optical axis, by a mechanical arrangement, fairly good of its kind. The screen, which is of an optical dispersive

character, the projected image being seen through it, consists of several sectors, mounted step-like in several different planes normal to a common axis of revolution. The projected image may occupy about one-sixth of the area of the screen, near to its edge. The screen may be rotated by an air-jet acting on vanes "or any of the other motors used for zoetropes."—*The Optician*.

BACTERIOLOGY.

Savelieff's Method of Preserving and Examining Sputum for Tubercle-bacilli.—The object of this process is to preserve the sputum until examined. In 1890 Savelieff (a Russian investigator) suggested a very convenient method for preserving the sputum and examining it bacteriologically at a more or less remote date after its expectoration. It consists in having the patient expectorate in a dish containing 95 per cent. alcohol, in which medium the discharge can remain for several months. As the sputum is hardened in the alcohol (through dehydration and coagulation), Savelieff liquefied the coagulated sputum with a solution of caustic potash prior to making the cover-glass preparations. The technique employed was to remove a small lump of the coagulum, place it upon a slide, and add a few drops of caustic potash solution, which reduced the coagulum in a very few minutes to a more or less pasty consistency, from which the preparations were made. After drying, they were rinsed in water, to remove the potash, and stained. The film was fixed by passing the cover-glass three times through the flame of an alcohol lamp or Bunsen burner. Thus prepared, the preparation was stained by some familiar method.

Yeasts and Bacteria of Natural and Artificial Wines.—MM. Schaffer and von Freudenreich have reported on the micro-organisms existing in natural and artificial wines, and, considering the method of manufacturing and composition of these latter, the authors' results are not surprising.

Of the ten natural wines examined only one contained bacteria, and this one, from imperfect treatment, had always been cloudy. Wines which had been several years in bottle were sterile, containing neither yeast nor bacteria. Artificial wines contained numerous bacteria, and the authors throw out the suggestion that the presence of these bacteria may have some connection with gastric disorders.—*Four. Royal Micr. Society*.

The Bacteriology of Tobacco.—In the process of "sweating," during which are formed many of the aromatic compounds upon which the flavor of tobacco depends, the result varies greatly with the kind of bacteria which take the chief part in the fermentation. German growers of tobacco have tried in vain to improve the quality of their crop by enriching the soil and by

introducing foreign sorts. Suchland, however, by starting the sweating process with pure cultures of germs obtained from the finer foreign tobaccos, has been able so to influence the flavor of the German weed as to deceive experienced connoisseurs. — *Abst. Centralblatt f. Bact.*, xii, 20.

MEDICAL MICROSCOPY.

The Origin and Character of Cancer.—Microscopical research has furnished a theory of the character of cancer otherwise lacking. It is believed that in the wide group of maladies comprised under this term we have a reversion of the normal cells of healthy tissues to a primitive embryonic condition, wherein each cell becomes a quasi-independent creature, comparable with the amœba, and which preys upon the other tissues as a parasite, or rather as an autosite.

The various grounds, microscopical and clinical, on which this theory is based were recently discussed before the Western Microscopical Club in London. Dr. Herbert Snow alluded to the occurrence of auto-inoculation, whereby spontaneous grafting of minute fragments detached from the primary tumor infects distant, and, perhaps, numerous parts of the patient's body. Contrasted with this case of self-inoculation is the extreme difficulty of procuring purposive cancer-inoculation in the lower mammalia. With the exception of a numerically small group due to the remnants of foetal structures not entirely obliterated after birth, in which the disease appeared to arise spontaneously, the dread malady was almost restricted to the elderly and old on the one hand; on the other, either to organs which were normally undergoing devolution after having fulfilled their period of functional activity, as in the female, or to parts whose vitality, for some obvious reason, become impaired, as happens ordinarily in the male sex. Blows, excessive smoking, and neglected dental irritation were cited among such reasons for attack.

Cancer picks out a solitary individual here and there—has no even probable association with climate—and attacks civilized races only. But it attacks them regardless of the part of the globe in which they live. In these respects it is strongly contrasted with those diseases commonly ascribed to the action of microbes. In England and Wales alone it claims some 20,000 victims annually. Two-thirds of these are females past the prime of life. The number increases year by year, as the struggle for existence becomes more and more severe, and as the conditions of life get less and less natural. In this respect, cancer stands alone, no other disease showing a progressive increase. The interest attaching to this unenviable peculiarity should lead to renewed efforts to solve completely this serious problem.—*E. Mechanic*.

MICROSCOPICAL NOTES.

Fine Writing.—Some time ago a Paris paper offered a prize for the best specimen of microscopic handwriting, and several wonderful examples of skill with the pen were sent in by competitors. The winner of the prize was a man who had copied out in full on a postcard the contents of the first two pages of a big newspaper. Another candidate, ingeniously alluding to the famous incident, wrote on an egg an account of the career of Columbus. A third submitted the 19,000 words of Francois Coppée's novel of "Henrietta," written on the back of a cabinet photograph. The doers of such feats seem to have small regard for their eyesight.

Decay in the Apple Barrel.—Prof. Byron D. Halsted contributes a fully illustrated article to the *May Popular Science Monthly* upon this topic, and we recommend its perusal.

MICROSCOPICAL SOCIETIES.

BUFFALO MICROSCOPICAL CLUB.

Monday March 13, 1893.—The evening was devoted to a manufacturers' exhibition of microscopes and accessories. The following firms accepted and took part: Spencer & Smith, Buffalo; Queen & Co., Philadelphia; Joseph Zentmayer, Philadelphia; Bausch & Lomb, Rochester; Gundlach Optical Co., Rochester; E. H. Griffith, Rochester. A reduction from catalogue prices was granted members of the club and physicians on all orders placed with these firms during the evening.

MICHIGAN TEACHERS' SOCIETY OF MICROSCOPISTS.

June 21, 1892.—The first annual meeting was held in the biological laboratory, Michigan State Normal School. Several members were unable to attend, being still engaged in the closing work of their schools in various parts of the State. Progress of the society during the past year was briefly reviewed by the president. Wm. W. Wier, of South Frankfort, presented a paper on the use of the microscope in school. Remarks by J. Q. Roode, of Hanover, along the same line. Treasurer's report showed a small amount of cash on hand, and no debts. Election of officers resulted: president, C. D. McLouth, Muskegon; secretary, F. E. Andrews, Ypsilanti.

This society was organized in June, 1891, with a membership small in number but enthusiastic for the object of the association, which, in the language of the constitution, is "To encourage the use of the microscope as an educational factor in the schools of the State." The organization gives promise of usefulness, and increased membership is desirable.

CHICAGO ACADEMY OF SCIENCE, MICROSCOPICAL SECTION.

At the last meeting of the Section of Microscopy of the Academy of Science Dr. W. H. Knap was elected chairman, and Prof. F. L. Morse was elected recorder for the ensuing year. Mr. H. L. Tolman, the retiring chairman, delivered a most interesting talk regarding his trip to Europe last year under the auspices of the World's Fair authorities. He was assured of a large exhibit of microscopes and accessories from the leading foreign makers. This exhibit will be classified and exhibited in the space secured by the Illinois State Microscopical Society and will be under the care and supervision of the section of microscopy of the Academy of Science, which was formerly the Illinois State Microscopical Society. Permission was freely given by all the prospective exhibitors to have stands and accessories shown and used at the meetings of the section. When it is considered that Powell & Leland, Zeiss, Nachet, Ross, Seibert, Lutz and other European makers will send their finest productions here, not excepting Zeiss' famous objective of 1.63 n. a., and that we shall have the privilege of examining them, it is not at all improbable that next year will be one of great interest to microscopists.—*Inquirer*.

NEW PUBLICATIONS.

Primary Microscopy and Biology. By Albert Schneider, M. D. 8vo, 100 pp., 20 cuts. Price \$1.

This book will answer as a guide for any beginner, as it is strictly elementary and contains a little of everything. A dozen pages are devoted to mathematical demonstrations of the physical properties of lenses. These pages could easily have been omitted, as beginners will not feel much interest therein. Another dozen pages contain necessary descriptions of microscopical apparatus. In another chapter are some discussions of life and of the groundwork of biology, which are interesting for novices, and intended as introductory to some simple microscopical experiments.

Directions for elementary microscopical work upon starch, pollen, yeast, insects, amœba, and vegetable tissues constitute the most important parts of the book. A chapter on vegetable histology is very good. A dozen useful formulæ are labelled "recipes," and an analytical table of contents placed at the end of the book is misnamed "Index."

The printer made a good many blunders, a part of which are noted in an "errata" sheet.

The author is modest, claims but little, and so gives all that he pretends to give.

Some Features of the World's Columbian Exposition. Queen & Co., Phila.

This is a neat brochure of 16 pages designed to advertise their exhibit.



REV. FRANCIS WOLLE

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No. 7.

Notice of Rev. Francis Wolle,

BETHLEHEM, PA.

[Author of *Diatomaceae of North America*, etc.]

WITH FRONTISPIECE.

After a painful illness of seven weeks, Rev. Francis Wolle died at four o'clock on the morning of February 10th, 1893, at his home in Bethlehem and surrounded by the members of his family.

Francis Wolle, a son of John Frederick Wolle, merchant of Bethlehem, and Sabina Henry, his wife; was born at Jacobsburg, near Nazareth, Pa., Dec 17, 1817. He was one of seven sons. After his school days, he spent most of his early life in teaching, first at Nazareth (Nazareth Hall), and then in the higher departments of the Parochial school in Bethlehem.

Three or four of his earlier years, prior to 1838, were spent at home where he aided his father in business. At this time, he originated the idea of an easier way to produce the necessary paper bag of a country store. In 1852, he obtained his first patent, the first issued in the United States, and probably the first in the world for a machine for such purposes. On July 6th, 1848, he was married to Elizabeth Caroline (Weiss) Seidel, daughter of Jedediah and Mary Weiss of Bethlehem.

In 1861, Mr. Wolle was ordained a deacon, and in 1867, a presbyter of the Moravian Church. In the year 1857, he assumed the duties of vice principal of the Moravian Seminary for Young Ladies, of Bethlehem, his brother, Sylvester Wolle being principal. In 1861, he took the entire charge of the institution and continued to hold the principalship until 1881 when he retired to private life.

During the period of his connection with the seminary as principal and vice principal, upwards of three thousand students were admitted.

The study of natural history was his favorite pursuit from early boyhood, and afforded him enjoyment and recreation when he was not too hard pressed with official duties. Entomology occupied many a leisure hour, but in later years his attention was directed more exclusively to botany, primarily to the phænogamous plants and then to several branches of cryptogams, especially to the *Musci hepaticæ* and the Fresh-Water Algae of the United States. In 1884, his first volume made its appearance from the Moravian Publication concern, in a handsome royal octavo volume, "Desmids of the United States and list of Pediastrums," with eleven hundred illustrations on fifty-three colored plates. The illustrations were photo-lithographs from India ink sketches, the work of his own hands.

This volume was followed, in 1887, by two more volumes: "The Fresh-Water Algae of the United States," complementary to "Desmids of the United States," one volume containing the text, and the other the illustrations, with 2300 figures, covering 157 colored plates.

In 1890, appeared the volume, "Diatomaceae of North America," illustrated with twenty-three hundred figures from his own drawings on one hundred and twelve plates. His botanical and literary work ended with the "new and enlarged" edition of the "Desmids of the United States," which he completed in the summer of 1892. His health gradually failing, he then gave up all study and investigation and died but a few months afterwards.

The Contractile Vesicle.

By DR. ALFRED C. STOKES,

TRENTON, N. J.

It is not surprising that the contractile vesicle in certain of the lower microscopic animals should have received the attention which has been bestowed upon it. The organ is usually conspicuous, and the microscopist's interest is sure to be excited by it, and his imagination set to work to account for its action

and its possible utilitarian purpose. But there are certain functions of the contractile vesicle which do not call for even the "scientific use of the imagination," as they may be demonstrated if not at all times at least occasionally, and sufficiently well to leave no doubt; and if not in all microscopic animals of the lower classes, at least in enough to warrant trustworthy conclusions.

If we examine certain of the naked, fresh-water Rhizopods, *Actinophrys sol* for instance, or *Actinospharium eichhornii*, there will not long be any doubt as to the manner in which the contractile vesicles discharge their contents, nor where.

In these common, soft-bodied creatures of the ooze, the contractile vesicles rise slowly from the surface of the ectoplasm as gradually enlarging hemispherical protuberances. Without warning they collapse and, under a moderately high magnifying power, the point at which they disappear seems to sink into the body with such violence that the shock usually jars the entire animal, and informs the observer when the contraction has been accomplished, although the vacuole may be on the opposite side of the Rhizopod and not distinctly visible. With greater amplification, in my own case with the use of a homogeneous immersion $\frac{1}{2}$ N. A. 1.43, and an oil-immersion 1-12, N. A. 1.40, important details may be noted. These are similar in both Rhizopods, being rather more conspicuous and more easily seen in *Actinospharium eichhornii* than in *Actinophrys sol*, simply on account of its greater size.

When the vesicle has reached its point of greatest expansion, that is, when the diastole is complete, its surface is entirely smooth, but as it contracts the whole becomes studded with projections which are hollow, nipple-like and of unequal lengths, each villus communicating directly with the cavity of the contractile organ and being filled with the same contents. These projections are forced out from the general surface of the vesicle with violence, their free extremities becoming suddenly rounded as if through quickly applied pressure from within, the entire performance reminding the observer of the childish sport of blowing into a kid glove to see the inflated fingers leap up. The quickly produced appendages are either slowly withdrawn and so made to disappear, or they are smoothed out by the gradual dilatation of the swelling vesicle.

Although I have not actually seen minute streams issuing from the extremity of each villus, there can be but little doubt that streams do so issue. If the limiting membrane is pierced by apertures they must be infinitely more minute than are the secondary apertures in any known diatom; and the proper conditions for demonstrating the perforations, if they exist, cannot be made, as they can be made with a diatom; yet the sudden protrusion of the nipple-like processes with the hypothetical aperture at the extremity of each, is precisely what reason would suggest as the result of the rapid movement of a cribriform vesicle, the enclosed fluid being restrained in the rear by the resisting body-substance. The amount of liquid in the vacuole is small, and although the internal force that protrudes the villi seems, under the microscope, to be comparatively great, it must of course be exceedingly slight. Yet it is great enough to produce a surprising change in the appearance of the external surface.

Dr. Leidy, speaking of the contractile vesicle of *Actinophrys sol.* says: "Gradually expanding, it rises as a film of granular protoplasm, which, becoming thinner and thinner, finally bursts and gives exit to the liquid contents." In reference to the two vacuoles of *Actinosphaerium eichhornii* he says: "On reaching the full degree of expansion, they rather abruptly collapse, and expel the liquid contents." And the new edition of "Carpenter," referring to the contractile vesicle of *Actinophrys*, says: "The cavity of this sacculus is not closed externally, but communicates with the surrounding medium,—not, however, by any distinct and permanent orifice, the membraniform wall giving way when the vesicle contracts, and then closing over again."

The vesicles of *Actinophrys* do not burst. From what I have repeatedly observed and have here described, I am convinced that there is no such action. If rupture actually took place, it could be readily seen, since the vesicle is large; in *Actinosphaerium eichhornii* it should be noted with much greater ease as the organs are there still larger. But what does take place is the sudden protrusion of the nipple-like processes, with apparently the forcible ejection of the vacuole's liquid contents through them.

With the Infusoria it is not always possible to demonstrate the existence of a passage from the contractile vesicle to the

external water, yet it can be done, and it has been done. Indeed, I have personally had the satisfaction of doing it.

Students of this class of microscopic animals believe that the endoplasm is everywhere pierced by exceedingly minute canals which lead to the contractile vesicle, and pour into it whatever they may have received. These more than microscopic channels cannot be seen, but that something, corresponding at least in function to such canals, exists within the infusorial endoplasm, there can be no doubt. And if even in the largest Infusoria, they are too minute to be seen with the best of modern objectives yet do not fail in their function of carrying liquid to the contractile vacuole, their invisibility is no argument against the existence of minute pores in the extremities of the surface villi on the contractile vesicles of the naked Rhizopods referred to. It is not making an unreasonable use of the imagination to say, that the conduct of the contractile vesicles of *Paramæcium aurelia* suggests exactly that interpretation. These vesicles are normally sub-spherical; it is usually only when the animal is in distress, or is pressed upon too heavily by the cover-glass, that they assume the stellate form with the branches radiating from a central vacuole outwardly into the endoplasm. Is it not reasonable to suppose that the contents should then be backed up into these ordinarily invisible channels to distend them and to make them conspicuous? It is absolutely beyond a doubt that the Infusoria and other microscopic animals have no more control over the pulsations of their contractile vesicles than the human being has over the movements of his own heart. If the contrary was the case, there need not be any undue enlargement of the vesicle, or any backing up of the vacuolar contents in these conditions of uncomfortable pressure, or of uncongenial surroundings.

No aquatic microscopic animal can swallow a particle of food without at the same time swallowing a greater bulk of water. It is an every-day occurrence to see an Infusorian engulf a smaller, living animal, which is accompanied into the endoplasm by a comparatively huge drop of water. And it is a common occurrence to see that animal live and move and struggle until the water-drop has been absorbed so as to allow the food-mass to come in actual contact with the digestive protoplasm. What becomes of that water? Infusoria are voraci-

ous creatures and they are forced to swallow large quantities of water. What becomes of it? Is it regurgitated through the pharyngeal passage and the oral aperture? If it is, then it passes up against a powerful ciliary current setting in in the opposite direction. If there should be no way of disposing of it, would not the ever-hungry creatures become dropsical to the point of explosion? The fact is that they never do.

It is the generally accepted belief of microscopists that the invisible channels ramifying throughout the endoplasm collect this liquid and carry it, with any excretory products, to the contractile vesicle whence it is expelled into the surrounding water. It is not easy to color the contents of this contracting organ, yet it has been done. It is no light task to demonstrate that its contents hold uric acid in solution, yet that has been done. Such experiments fail oftener than they succeed, but they do succeed. I do not think that a gas could be stained.

These canals are supposed to be neither permanently fixed in one position nor to have a special lining membrane, being, in the latter respect, like the contractile vesicle itself. It is believed that they open anywhere within the endoplasm, through which they may not take the same course twice in succession; and that the fresh water imbibed with the food, and that absorbed through the body-surface, at some time surrounds every particle of protoplasm in the organism, and gives to it its needed oxygen, taking in exchange the useless excretory products and carrying them to the contractile vesicle, whence they are expelled. If the protoplasm of the Infusoria is reticulated, as it probably is and as that of *Pelomyxa palustris* and of the *Amœba* surely is, then these channels are not necessary to explain the collecting of the liquid, for if the reticulated structure exists, the circulation of the water amid the meshes of that living network would be a beautiful contrivance, and would render superfluous the formation of water-canals anywhere except near the contractile vesicle to lead the liquid into it. This is the arrangement which I believe to be present, although it is not possible to do anything whatever toward demonstrating it. Yet it explains certain phenomena readily observable, and otherwise not readily accounted for.

Uric acid crystals, or what amounts to the same thing, murexide crystals, have been seen within the contractile vesicles of the

Infusoria, within the five pouches of the stomach of the Echinoderms, in the segmental organs of the leeches, of the Oligochaeta and of the Polychaeta.

Griffiths of Edinburgh, has demonstrated the presence of murexide in the contractile vesicles of *Amœba*, of *Paramœcium* and of *Vorticella*. The process is to place a number of the animals on a slide and to cover as usual. They are then killed by alcohol, which is to be followed by nitric acid. The slide is gently warmed and ammonia introduced, when, if the experiment succeeds, the purple, prismatic crystals of murexide will make their appearance in the contractile vesicle, showing that uric acid had been present there. I do not think that a gas could hold uric acid in solution any more easily than it could be stained.

"Through all the multitudinous changes" says Griffiths "that have taken place during the lapse of ages, in the development of the mammalian kidney, we find that the physiological functions are the same as occur in its original or primitive form as represented in the Protozoa. It is not going too far to say, that within these lower forms of animal life we have all the necessary mechanism for the creatures to breathe, digest and excrete. The only difference is that in the Protozoa the cell performs numerous functions, whereas in the Vertebrata these functions are localized in special organs." And Huxley says, " * * * * the vertebrate kidney is an extreme modification of an organ, the primitive type of which is to be found in the organ of Bojanus of the Mollusk, and in the segmental organ of the Annelid; and, to go still lower, in the water-vascular system of the Turbellarian. And this, in its lowest form, is so similar to the more complex conditions of the contractile vacuole of a Protozoon, that it is hardly straining analogy too far to regard the latter as the primary form of uropoetic as well as of internal respiratory apparatus."

Many theories have been propounded as to the final disposal of the watery contents of the vesicles. Those that think the contents are a gas, as Dr. Albert Schneider (AMER. MO. MICRO. JOURNAL, March, 1893), is fully convinced that they are and that this gas is forced into the general system by the pulsations of the organ, would do well to study the optical action of a gas-bubble and of a drop of liquid enclosed within the endoplasm

of a living microscopic animal. It may be easily done. The common Rhizopod, *Arcella vulgaris*, is abundant everywhere in the surface-ooze of our shallow ponds. Beneath its shell there is frequently formed a bubble of gas, just how it is produced I do not know, but near it, often beside it, may be seen one or more of the animal's contractile vesicles. It is not necessary to prolong the study of the optical action of each of these, to observe that not to discriminate between a gas-bubble and an enclosed drop of a watery liquid, should be impossible.

It has been my good fortune to observe the actual ejection of the liquid contents from the contractile vesicle of an animalcule. An Infusorian was encompassed by a cloud of bacteria and of similarly minute bodies or debris, through which, at every contraction of the vacuole a narrow path was swept with a quick puff, as a passage might be made through the dust by the sudden blast of a bellows. I studied the effect of the something which issued from that contracting vacuole, and that that something was a liquid I assume; that it was not a gas-bubble I know. Gas could have been seen to escape, and it would have collected under the cover-glass where it could have been recognized, although I am not unmindful of the fact that a bubble has been described as a cancer-cell, and as the microbe of la grippe!!

In some Rotifers the channel leading from the contractile vesicle to the external water may be seen and studied at every contraction of the organ. Here the passage is permanent, and although it is closed and invisible except when the liquid is issuing, it is then conspicuous. Yet even in these favorable conditions I have never seen any effect produced by the ejection, probably because the quantity of liquid expelled is exceedingly small, and because there never happened to be sufficient flocculent matters near enough to the animal's body to be influenced by the slight force of the issuing current. In other Rotifers the vesicle discharges its contents into the lower part of the intestine.

DR. SEIGFRIED CZAPSKI of Jena, one of the members of the famous "Carl Zeiss" Optical Company, will be present at the meeting of the American Microscopical Society at Madison, Wis. August 18. He will read an essay and give a demonstration.

Fungus Diseases of the Sugar-Beet.

By L. H. PAMMEL,

AMES, IOWA.

[From Bulletin No. 15, Iowa Agricultural Experiment Station.]

I.—BEET RUST.

This disease is caused by a fungus (*Uromyces-betæ*) and has long been known in Europe. Its life history was worked out by Kuehn in 1869.

This, like many others, is characterized by having three stages, the accidio (cluster-cup) stage, the uredo (red-rust) stage, the teleuto (winter) stage. The first or accidium-stage occurs on the petioles, leaves and stems of "seed beets." In this stage two kinds of spores are produced: in one kind, the spores are contained in flask-shaped receptacles known as the spermogonia. These spores are incapable of germination. The spermogonia appear somewhat earlier than the cluster-cup itself. The cluster-cup when opened contains chains of orange yellow colored spores. The spores are so compact in the cup that they are polygonal in outline. They arise from short threads at the base of the cup and are known as basidia. The accidio-spores germinate under favorable conditions, the tube entering the leaf of a beet through small rifts known as stomata. In the tissues of the leaf a mycelium is formed which develops in the intercellular spaces. The thread sends out small lateral outgrowths into the cell known as haustoria which absorb nourishment from it. It requires only a short time until the mycelium collects in certain places beneath the epidermis, from which there arise short upright threads which bear small, one-celled spiny spores, known as uredo-spores. These have small bright spots in the cell-walls which are perforations through which the germ-tube passes. This tube enters the leaf through the epidermis. The uredo-spores germinate immediately and spread infection to neighboring plants. Late in the season another kind of spore is found. It is known as the teleuto-spore. They are one-celled, thick-walled, smooth and of darker color. They have attached to them a short branch known as the pedicel. These spores occur in sori by themselves on the petiole or in some cases with the uredo-spores. The winter spores do not

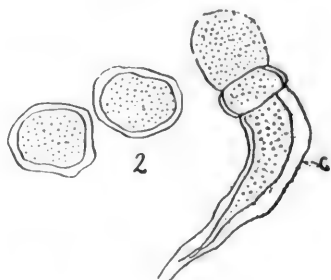
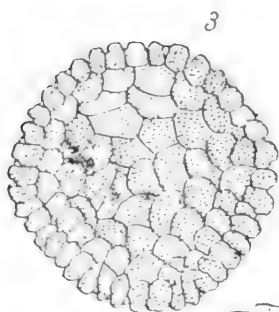
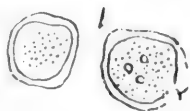
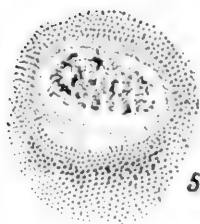


PLATE I.

germinate till the following spring when a tube known as the promycelium comes out of a thin place at the apex of the spore. This tube is branched and bears small lateral bodies known as sporidia. These germinate, and when falling on the proper host, i. e., "seed beet," produce the accidium-stage.

II.—WHITE RUST OF BEETS.

This fungus (*Cystopus blitii*) produces white pustules on both sides of the leaf (Plate I, fig. 4). The mycelium of the fungus vegetates in the interior of the leaf occurring in the intercellular spaces. These threads send out small haustoria which take up nourishment from the cells. The fungus threads collect in certain places from which arise erect threads known as conidiophores (Plate II, fig. 2c). From the end of this thread, spores (Plate II, fig. 1 and 2) are cut off, sometimes five or six are found in one chain, the outer being the oldest. The conidiophores and spores are found in large numbers just underneath the epidermis. When sufficient growth has taken place the epidermis or outer layer of cells of the leaf is broken and the white powdery spores are exposed. The outer spore of the series has a thick cell-wall in many cases, and is said not to germinate. Germination of the other spores consists in breaking up of the protoplasm of the spore into eight parts which become zoospores. On escaping from the spore these soon come to rest when a thin cell-wall is formed. It then germinates and enters the stomata. Another kind of spore is formed later in the season known as the oospore. These are the resting or winter spores.

The sexual method of reproduction is as follows: The mycelium or vegetative part of the fungus enlarges at the ends of the branches, soon a round cell is cut off, the protoplasm separates into two portions, the outer is used to build up the walls of the spore while the center (oosphere) receives the fertilizing material. The whole is called the oogonium. While the oogonium is forming another branch is sent up from the same thread which produces the oogonium but below it or in some cases, this arises from another branch. This bent or club-shaped body is called the antheridium. It is the male reproductive body. The antheridium enters through the wall of the oogonium and the protoplasm passes into the oosphere. As a result of this

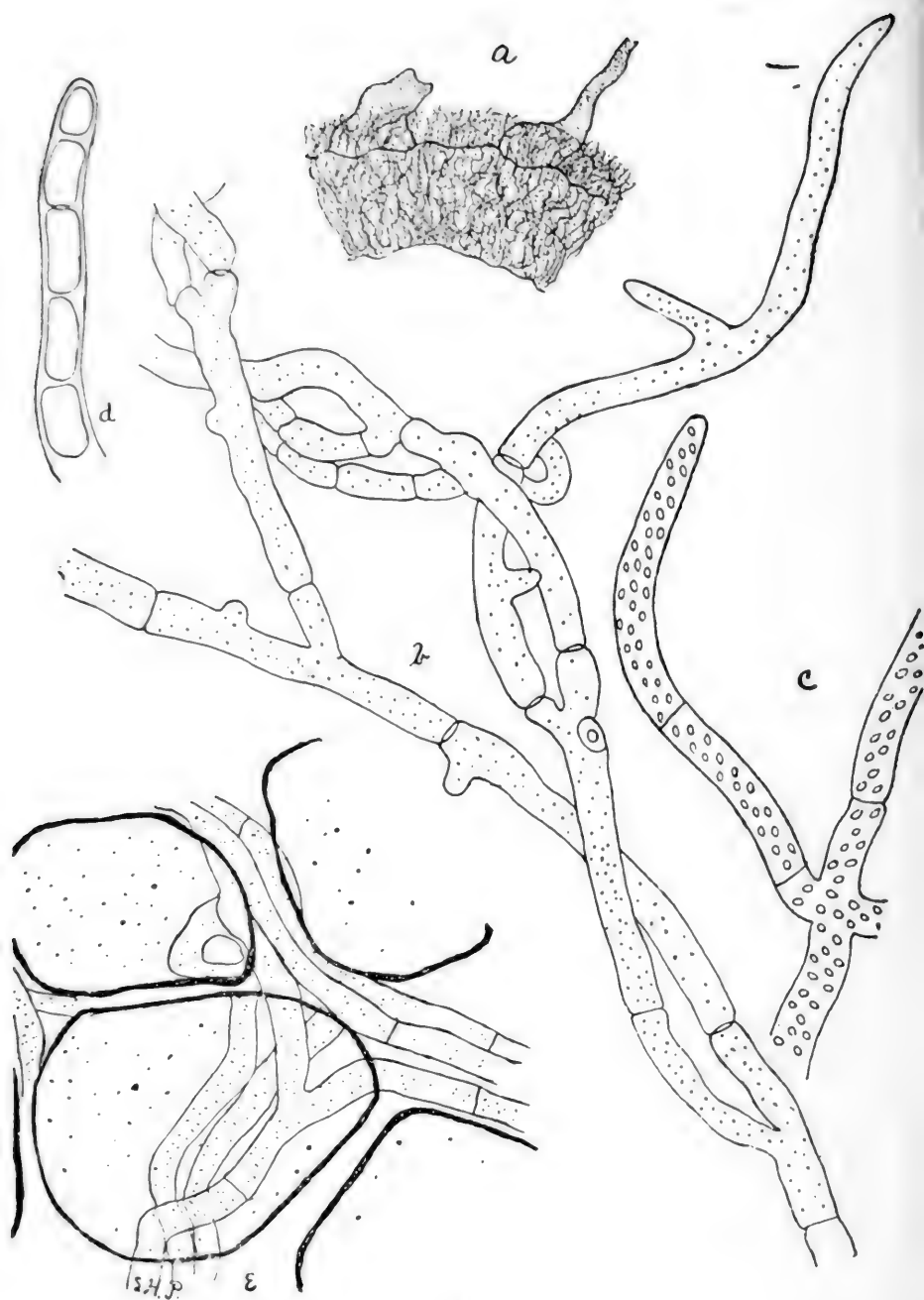


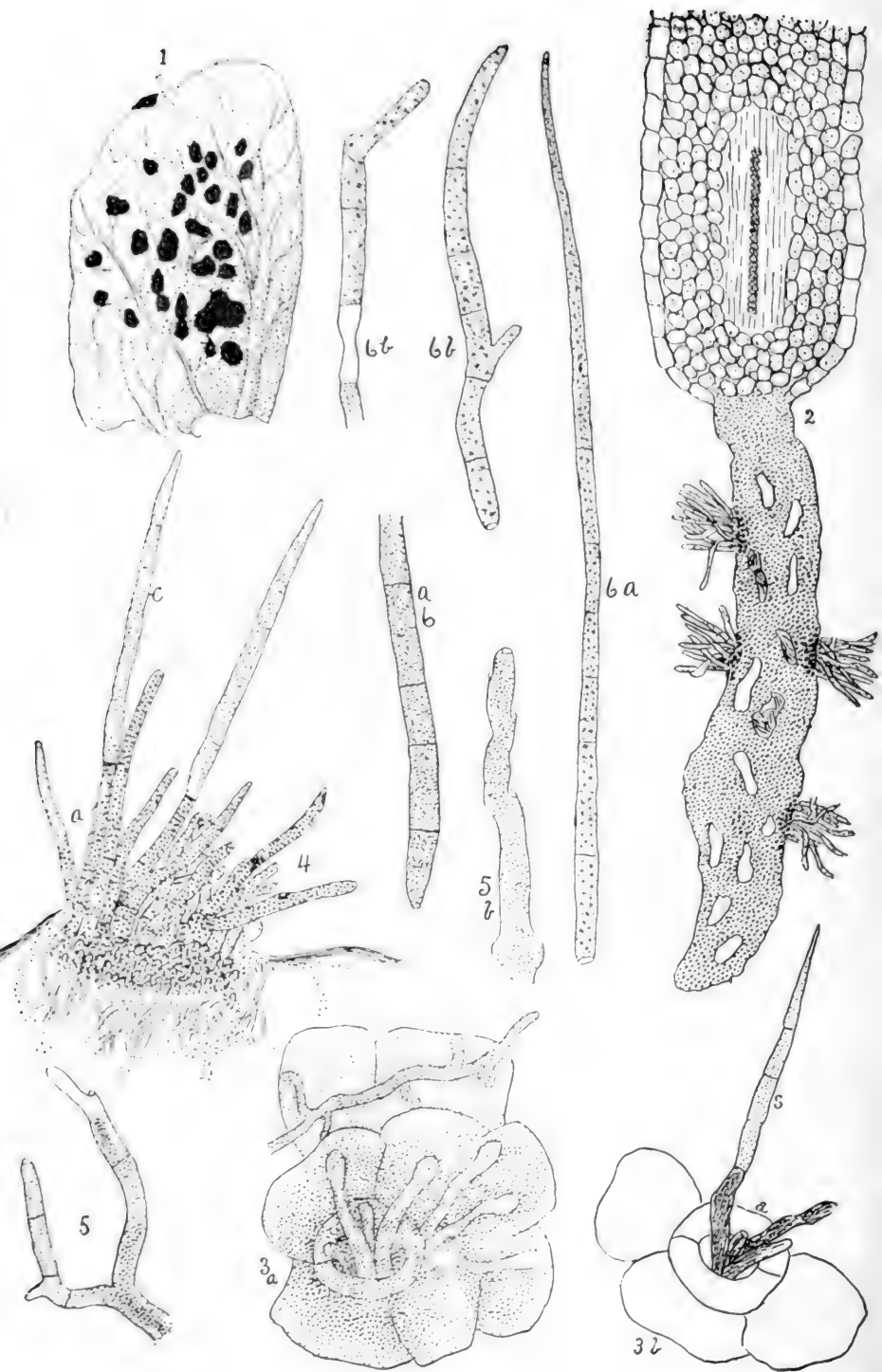
PLATE II.

fertilization a thick-walled spore is produced, the oospore. The outer part is roughened (Plate I, fig. 3).

The oospores lie dormant for sometime. They germinate in the presence of water, the contents of the oospore break up into a number of small bodies which when free are provided with two cilia. These are called zoospores. After a short time a wall is formed about them. The zoospore germinates and enters the leaf through the stomata where an abundant mycelium is developed which in a short time produces the conidia or white-rust stage. Although this disease is not so destructive as some of the downy mildews, seldom causing a total destruction of the leaf, except in some cases where the stems of flowers become abnormally enlarged as in the white-rust on mustard-radish (*Cystopus candidus*), it may cause some damage.

III.—SPOT DISEASE OF BEETS.

This disease (*Cercospora beticola*), manifests itself on the leaf by producing round spots, at first not larger than a pin head. Gradually these spots increase in size, becoming round, elliptical or irregular in outline (Plate III, fig. 1). Frequently they run together and form one large patch. The spots occur on both upper and lower sides of the leaf. There appears to be no difference in regard to the formation of spots on the upper and lower surface of the leaf, occurring as frequently on one side as the other. The spots are of a pale brown color when the leaf is green, but later become darker. The sides of the spot where the spores arise are of a lighter color, the margins being pale brown when the spores are forming. Most of the spots are about one-eighth of an inch in diameter, though some of the larger are nearly one-half inch across. The spots frequently run down the petiole, giving it a black appearance. One small leaf, four and one-half by two and one-half inches, had something over one hundred spots of various sizes, and this was a newly affected leaf. In very old specimens the spots are much more numerous. In fact, they were colored black from the effects of the fungus. In badly diseased patches the lower leaves were all black. They were dead or in the process of wilting, while the upper or center leaves were becoming discolored by the fungus.



IV.—CHARACTERS OF THE FUNGUS.

Examination of one of these spots with a hand lens will show that the tissues of the affected leaf are shrunken, making the border of the spot on the side where the spores of the fungus appear elevated. In the spots small threads that resemble fine hairs can be seen readily. Cross section through a diseased spot shows that the tissues are considerably shrunken (Plate III, fig 2); and of brown color. On both sides of the leaf, brown threads (conidiophores) pass out usually through the stomata. Frank states that the conidiophores or branches, which bear the spores, always pass out through the openings of the stomata. This is said not to be the case in a fungus (*Fusarium betæ* Rabh.) closely related to *Cercospora*. In *Fusarium betæ* the threads do not come through the stomata, but along side of it, breaking the epidermis. Von Thuemen states that the conidiophores of *Cercospora* break through the epidermis. Sorauer makes a similar statement. I find, however, that the conidiophores not only pass out through the stomata, but also break the epidermal cells (Plate III, fig. 3a). The conidiophores seldom occur singly, they are clustered or fasciated, usually simple, but in leaves which have been kept moist they are occasionally branched (Plate III, fig. 5). They are divided into cells, and at the upper end are knotty. The conidiophores arise from a mass of short cells of the fungus situated immediately underneath the epidermis. Coming from these short cells and passing into the tissues of the leaf is the mycelium, which at first vegetates between the cells of the leaf in the intercellular spaces. It destroys the cells, causing them to collapse and take on a brown color. The reproductive bodies are borne on the brown threads at certain definite points (Plate IV, figs. 3 and 4). The irregularities on the branches are due to the spores, which have fallen, leaving a little scar. The spores are long cylindrical bodies which taper towards the extremity. They vary greatly in length; in recently diseased green leaves they are short, but in black and damp leaves they are very long: they are plainly many-celled. When leaves are kept in a moist place the spots take on an ash gray color, owing to the immense number of spores which are formed. These are readily seen with a hand lens and look like plant hairs. When placed in a moist cham-

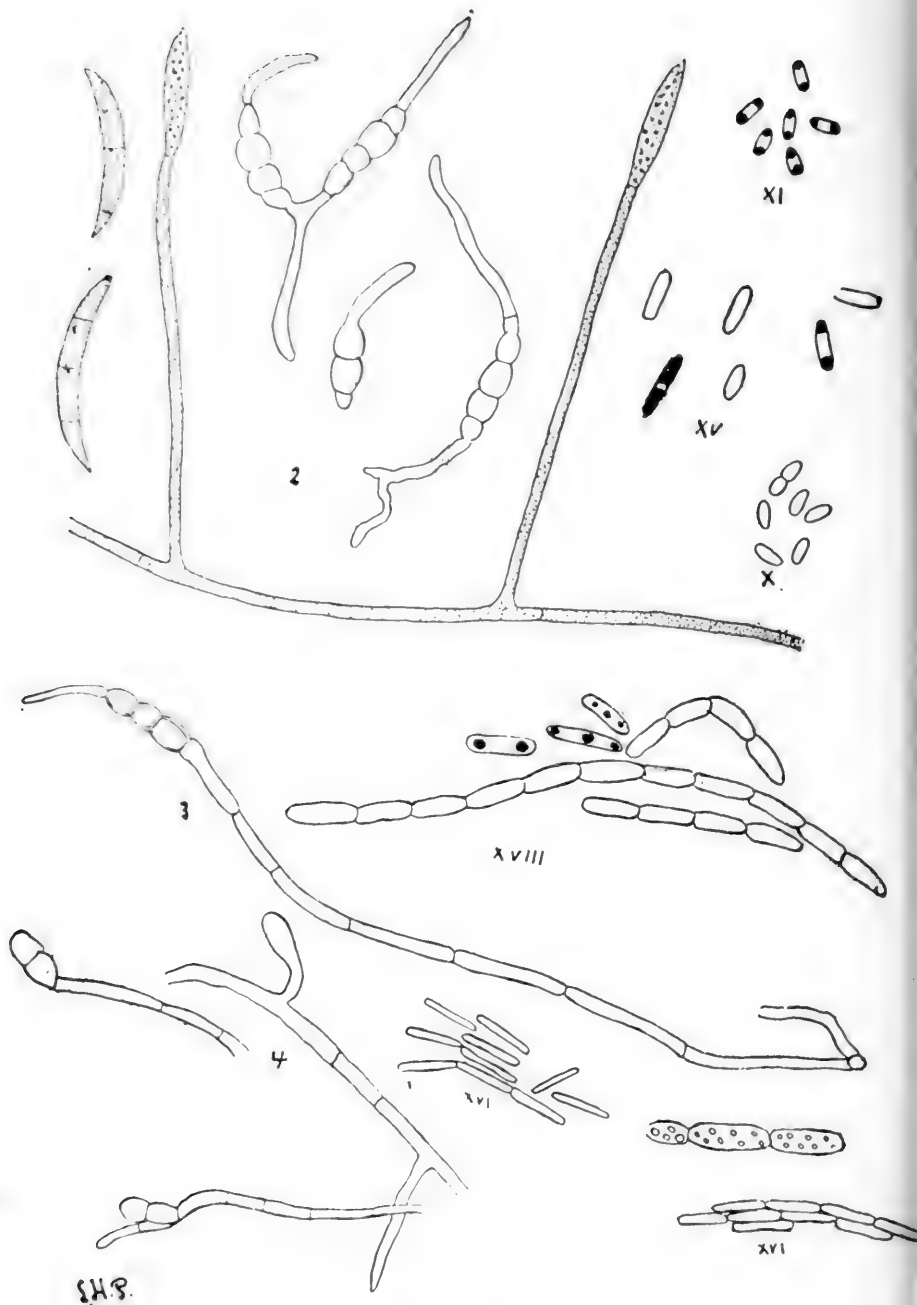


PLATE IV.

ber the spores germinate (Plate III, fig. 5b), each cell being capable of producing a germ tube. According to Von Thuemen this enters the beet leaf by way of the stomata. Once in the interior of the leaf a vigorous mycelium is produced, which in a short time gives rise to the brownish several-celled, fascicled and occasionally branched threads (conidiophores,) which bear the long needle-shaped many-celled nearly colorless spores.

These spores which pass into the soil with decayed leaves, are capable of infecting young beet leaves the following spring.

V.—THE VIOLET ROOT FUNGUS.

In 1855, Kuehn called attention to a serious root-rot of alfalfa, carrots and mangolds, in which a violet mould closely invested the roots. The disease caused dead patches to form in the field. The fungus causing the disease is known as *Rhizoctonia medicaginis*. It is the sterile mycelium of the perfect fungus *Leptosphaeria circinans*. This fungus has been found on alfalfa in Nebraska.

Kuehn has described a second root-rot disease of the beet, *Rhizoctonia betæ*. Our fungus appears to belong to this species. This fungus is very destructive in Germany, where it not only affects large beets, but young seedlings as well. This disease is said to produce on the surface of the beet brown spots which speedily enlarge. The diseased tissue is marked by producing a pale brown zone. The mycelium of the fungus advances in the tissue of the plant, causing a disorganization of the cells of the beets, the fungus apparently throwing off a ferment which prepares the way for the fungus. Sclerotia were also observed.

The Iowa disease manifests itself by a gradual dying of the plant. In plants where the root is not fleshy, death is sudden. This is also true of other root-rot diseases, especially root-rot of cotton caused by *Ozonium auricomum* and the violet root fungus (*Rhizoctonia medicaginis*,) when it affects alfalfa. The leaves of diseased beets are of pale color and more lax than in adjoining plants. However, these are not always the external manifestations, since diseased beets occur where there are no external symptoms. Like other root-rot diseases it occurs in patches spreading mostly in rows, though in some cases there is a tendency to spread radially. It may affect a single beet in a place, or a dozen or more are diseased. Early in September some of

these were completely decayed, the leaves were dead, some beets were less affected, the crown and one side was rotten, with a few leaves more or less curled. In some specimens the crown had a large hole (Plate I, fig. 6); in others, an elongated fissure occurred on the sides.

The exterior surface of the holes is closely invested with the brown mycelium of the fungus (Plate II, fig. *a*). This mycelium extends down the root, slowly advancing till all the smaller roots and rootlets are invaded. The plant then succumbs. It frequently happens that the disease has extended half way down the root, the lower part being perfectly sound. Just how these fissures are formed, I have not been able to make out. It may be due to a shrinkage of the tissues, owing to the attacks of the fungus or to a mechanical injury.

On pulling up affected beets, the diseased part invariably has soil adhering to it, while the undiseased is free. The border line is marked by a brownish color. In very young specimens it is reddish, with the tissues more or less shrunk. A cross section through this part shows that the branched, nearly colorless threads ramify between the cells and intercellular spaces, (Plate II, fig. *c*). Occasionally they penetrate the cell and occur in the cell-cavity. An affected beet placed in a moist chamber is soon covered with a very dense growth of the fungus. The figures (Plate II, figs. *b*, *c* and *d*), show threads of the fungus. Every specimen examined contained this fungus, and frequently many other saprophytic species. Rotting beets give off a very strong odor not unlike that of rotting potatoes.

Since publishing the above, quite a large number of sclerotia were found in rotting beets. They began to develop as white masses on the surface of the rotting beet, the exterior surface becoming greyish brown in color. These sclerotia were hard and smooth, shining, and greyish brown on the exterior surface. When fully mature the interior was made up of a white solid mass of branched hyphae. After a lapse of two months from the time that they began to develop, the fruiting form was produced, a species of *Coprinus*. Everhart and Ellis in *The Microscope*, (Vol. X, No. 5, p. 129), have described a species of *Coprinus*, the *C. sclerotigenus*, which is larger in every respect. The sclerotia of our species are not larger than a small-sized pea. The pileus and stipe are also smaller. It may be that our spe-

cies is *C. tuberosus* which was found growing from decaying vegetables in France.

There can be no question that the ultimate rotting is caused by bacteria; several have been isolated. Among them *Bacillus subtilis*, a very common species. A portion of raw beet was taken out, inoculated with diseased beet placed in an incubator at 42° C. The following morning it was covered over with the growth of a bacillus. A strong odor of boiled beets was given off, while the beet was black. This bacillus had developed to the exclusion of everything else. A second inoculation was made with a pure culture of the organism, but the results were not very decisive. The raw beet did not take on the sudden blackening, nor was the odor so decided. Some of the other bacteria found are shown (Plate IV, figs. x, xi, xv, xvi, xviii). Several other saprophytic fungi have been found, among them a species of *Fusarium* forming white patches. This appears to be *Fusarium betæ* which has been compared with a *Fusarium* on a beet kindly sent me by Mr. Ellis. The *Fusarium* is a secondary growth and is in no way responsible for the disease (Plate IV, figs. 2, 3, and 4). A *Fusarium* unidentified was found a few years ago on decaying beets in cellars. It may be responsible for some of the cellar rot.

VI.—SUMMARY.

The principal fungus diseases of the sugar beet are Beet Rust, White Rust of Beets, Spot Disease of Beets, Root-rot and Beet Scab. All of these diseases with the exception of rust occur in Iowa. Beet Rust is caused by *Uromyces betæ* and is closely related to bean, oats and other rusts. White Rust of Beets forms white blotches on the leaf, which consist of a large number of small spores. The fungus appears to be *Cystopus blitii*, which occurs on some of the Amaranths. Spot Disease of Beets manifests itself by producing round spots, at first not larger than a pin head, these spots become larger with age and finally cause the leaf to become black in color. The disease is caused by a fungus known as *Cercospora betæ*. The disease can no doubt be checked by Bordeaux mixture or ammoniacal carbonate of copper. Root-rot is caused by a fungus which appears to be related to *Rhizoctonia betæ*, a fungus discovered some years ago in Germany. It appears to have done some injury to the

sugar beet in Europe. The fungus causes a total destruction of beet, it is entirely worthless for sugar. So far the disease has not been reported from other parts of the state, though according to Prof. Galloway it occurs in Michigan. Rotation of crops should be practiced. Two root crops should never follow each other. Beet Scab, which has also been found in a few cases, appears to be identical with deep scab of potatoes. Sugar beets should never follow potatoes. In both diseases (Beet Scab and Root-rot), care should be used in cultivation. Cultivators and other implements should be kept rigidly clean. Do not pass from a diseased field to one where the disease does not occur. Infectious material is often carried in this way.

A Slide-Carriage and Object-Finder.

By F. L. J. BOETTCHER,

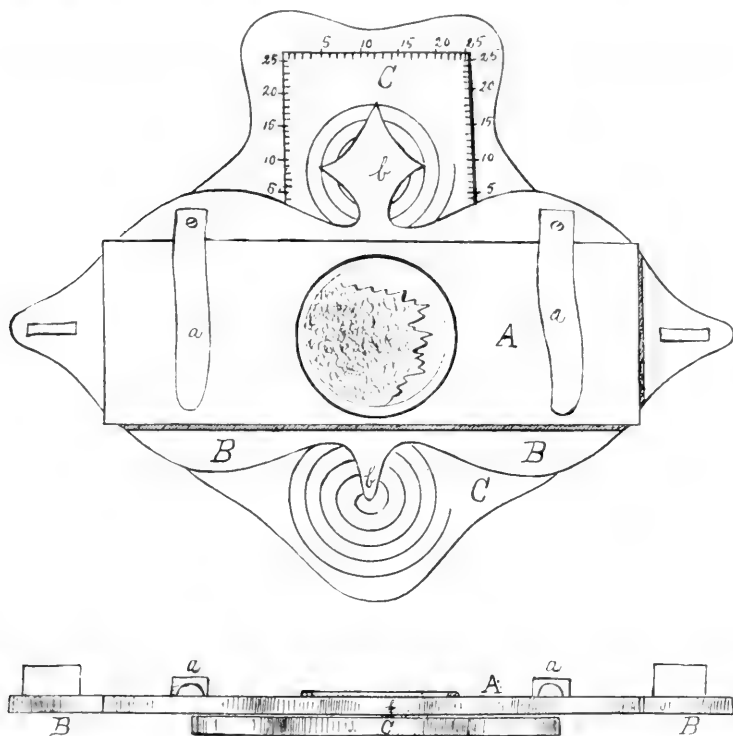
WASHINGTON, D. C.

It has no doubt occurred in the experience of many others, as it has in my own microscopical work that some item of minute dimensions, which had been passed over for future study or comparison, could not be found at the moment when it was most needed for examination or for exhibition. This difficulty sometimes becomes particularly embarrassing in the class-room, when after several minutes of fruitless search the vexed preceptor is obliged to confess: "Gentlemen, the thing which we are discussing is there, but it cannot be found at present: let us pass on." And no wonder, if we consider that even so low a magnification as 100 diameters will offer in an object 1 centimeter in diameter 70 to 80 fields, while a power of 600 will furnish 1500 to 2000 fields, and if the object sought for in a power of 600 measures 1 millimeter in diameter it will be 1/30,442.478 of the whole. It is sufficiently clear, therefore, that such a search can be successful only by mere accident or as a result of long and patient parallel motion of the slide.

I have had my share of these vexations. To overcome these difficulties and to add to the usefulness of the microscope, I submit this little contrivance. It is as simple as I hope it will be practical. Its object is twofold; first, to bring every part of the section, by the shortest route once under the microscope

and once only ; second, to enable any point in the section to be recorded as precisely and definitely as a star in a constellation.

In the accompanying figure, A represents the regulation slide, 3 inches by 1 inches, lying in a recess or hollow of the carriage, B, into which it fits closely and is held firmly by the clamps *a a*. The clamps being pushed aside it can easily be removed by its protruding corners. B, the carriage, lies firmly upon C, the table and contains at *b b*, two short pins which rest equally



firmly in the two spiral grooves. These two pins will direct the motion applied. The section describing exactly similar revolutions, as the pins *b b*, will bring exactly the width between the lines of the spiral groove under the focus as a definite part of the same, decreasing in diameter as the power of magnification increases. The diameter of the field and the space between the lines of the spiral groove can correspond exactly only with the

power for which the instrument has been made and the possibilities by between 50 and 250 diameter magnification. To find the actual field, measure the diameter of the field in millimeters and divide this by the previously ascertained magnification. The diameter of the actual field will be the exact distance between the lines of the spiral groove. In most instruments, 100 to 150 diameters give fields of 1 millimeter diameter, just wide enough for the grooves, while the powers beyond these furnish too small a space. It should therefore be exactly fitted for one of the lower powers on the nose-piece of the microscope. C, the table, is firmly but not permanently attached to the stage of the microscope by means of pins and sockets, clamps, or screws according to the stage of the instrument.

In summing up, therefore, it is claimed, that this instrument brings every portion of the slide in succession and by the shortest route into the focus of the microscope; second, that it admits of more definite estimates of the contents of a slide; and third, that any object on the slide may be easily and definitely recorded and found again with very little trouble. A patent has been applied for.

Two New Blood Stains.

By W. DRESCHER,

ROCHESTER, N. Y.

Microscopists and Clinicians have for some time felt the need of some method for the fixing and differential staining of the various formed elements of the blood. Many attempts have been made to answer this need, many methods have been suggested, none seeming, however, to combine so many of the essential qualities of a "good stain" as the method suggested and perfected by Dr. Ehrlich of Berlin.

We should add to our list of re-agents two of the blood-coloring solutions, now very generally used in Europe. In doing so, we aid in bringing them into more general use, particularly in the laboratories and hospitals of this country.

The stains are,—(1) Ehrlich's Neutrophile Stain, (2) Chenzin-skie's Eosin Methylene Blue Solution. The formulæ for which are as follows:

EHRlich's NEUTROPHILE STAIN.

Distilled Water,	100 parts,
Orange G, (saturated watery solution,)	135 parts,
Rubin S, (saturated watery solution,)	75 parts,
Distilled water,	100 parts,
Absolute Alcohol,	100 parts,
Methyl Green, (saturated aqueous solution,)	125 parts,
Aqua distilled,	100 parts,
Alcohol,	100 parts,
Glycerine,	75 parts.

CHENZINSKIE'S EOSIN METHYLENE BLUE SOLUTION,

Eosin (crystal), 1 per cent solution in 70 per cent alcohol,	20 parts,
Methylene Blue, (saturated watery solution),	40 parts,
Water distilled,	20 parts,
Glycerine,	20 parts.

The crystals, used in the preparation of these stains should be strictly of selected quality as it has been found that some of the same kind, but from different manufacturers, produce entirely different effects, especially the Methylene Blue which is obtainable from the one source only, where Dr. Ehrlich procures his.

A brief outline is here given of the manner of using these stains. The steps given are as followed by Dr. Ehrlich.

Have before you a piece of filter paper on which are placed a number of carefully cleaned cover glasses. These must be very thin, "extra No. 1". Wash the cover glasses first in strong sulphuric acid, rinse in water and place them for a few moments in glacial sulphuric acid; they should then be washed in flowing water until all the acid is removed, then transferred to 95 per cent alcohol from which they are to be taken and wiped.

Unless the cover glasses are thin and clean no good preparation can be made. In case the blood is taken from man, the finger is pricked with a steel pen, one of the prongs of which have been broken off. From the flowing blood a very small drop is caught on a cover glass near its edge and the glass quickly placed, blood side downward, on another cover glass which should be held in Ehrlich's Blood Cover-Glass Forcep, care being taken to cover the second glass only about one half. The blood will be seen to spread out between the two covers. Quickly draw one cover glass from the other; a thin layer of blood will in this way be spread on both slips. Ten to twenty

preparations are to be made in this way and placed, blood-side up on the filter paper before you and allowed to dry. If the blood is to be taken from a mammal, a small incision is made in the ear. From the flowing blood a small drop is caught on a cover as above described.

Amphibian or reptilian blood is obtained from the heart. The blood preparations may be fixed by placing them in a solution, composed of equal parts of absolute alcohol and ether, in which they remain for an hour as suggested by Nikiforoff or as Dr. Ehrlich recommends, by exposing them to a temperature of from 100° to 110° C. for from one-half hour to one hour.



In connection is used a very simple apparatus shown in above cut for fixing the blood preparations. It consists of a copper plate about 15 inches long, 4 inches wide and $\frac{1}{8}$ inch thick, resting on a metal support. The copper plate is heated at one end with an alcohol or gas flame. If then, at the end of fifteen minutes the glass rod which has been dipped into the water be passed over the plate, beginning at the end away from the flame, a place is reached where the water begins to boil. This region of the copper plate represented by a dotted line on the diagram is looked upon as having a temperature of 100° C. The blood preparations are placed on the plate (blood side up) between the flame and this imaginary line, near the line, and heated for a time differing with the stain used.

If the Neutrophile stain is to be used, the cover glasses on which the blood has been spread need to be fixed for fifteen to thirty minutes. The preparations are then placed, blood side

down on the stain where they remain about fifteen minutes; wash in flowing water for a few seconds; dry between filter paper; and mount in Canada Balsam. If the stain has been properly used the red blood cells should have a reddish brown color, all nuclei green, the Eosinophile granules red, and the neutrophile violet.

The steps for using Eosine Methyline Blue solution are as follows:

Fix the preparation by heating them on the copper plate for one hour; place on the stain for 24 hours, care being taken to prevent evaporation; rinse in flowing water, dry between filter paper, and mount in balsam. All nuclei will be blue, the blood cells red, and the Eosinophile granules red.

The Bausch & Lomb Opt. Company of Rochester, N. Y., have prepared a considerable quantity of this stain which has been very carefully tested at the Histological laboratory of the University of Michigan, giving the most excellent results. It is put up by them and obtainable in 2 oz. bottles at a very moderate price. Full directions for using the stains accompany each bottle. Of them may also be obtained the copper plate with support, as also the cover-glass forceps which is a very desirable accessory, serving a purpose not only for the above, but for other work as well.

ROCHESTER, N. Y., *July 25, 1893.*

Magnetic and Glassy Particles on House-Tops.

By K. M. CUNNINGHAM,

MOBILE, ALA.

Having taken an interest in the subject of a probable "cosmic dust," as reported by a contributor from Calcutta, India, to this JOURNAL (March, 1893, page 72), I am enabled to contribute additional details relating to the subject. A corroboration of the phenomena observed by him was invited.

What I have found has all the peculiarities of the dust found on the terraced roofs of houses in Calcutta, and reported to the Calcutta Microscopical Society. And its source of origin is fully explained, I think, in this wise. Wherever mineral coal is burned on a large scale, as in furnaces or locomotives, there

is a dense volume of Carbonaceous matter projected into the atmosphere, at various altitudes; that from the smoke-stack of the locomotive being least in height, but ejected with greatest expulsive force, as cinder and smoke; while that from high chimneys attached to manufacturing plants is delivered at an altitude of one hundred feet or more. These two conditions prevail at the point where I secured the specimens of material with which to elucidate the matter. I have occasion to expose daily, for the blue-copying process, a large polished plate of glass having an area of fifteen square feet of surface, and I observed that the surface every few days became covered with a coating of carbonaceous dust. It then occurred to me to collect this dust by brushing the entire surface with a soft roll of cloth. Gathering the residuum together and submitting it to microscopic inspection; I found the minute spherules, as described and illustrated in the JOURNAL. These were of varied characters, some very black and opaque, others transparent or opalescent and often filled with minute air-bubbles. Apart from the spherules, there was a variety of other mineral substances small crystals of calcite, small circular plates resembling diatoms of the *cyclotella* species, various transparent plant fibres, etc. This dust represented the finest particles that were transported in the atmosphere and would take the longest time to settle down.

This particular collection of dust particles did not fully settle the source of the dust; but as I observed a boy sweeping off the roofs of some box cars in the car-repair yards, I got him to hand me down a packet of the cinder dust. I sifted it through muslin and examined it under the Microscope, when I found it to be composed of myriads of the opaque, transparent, and opalescent spherules of the kind found in the dust brushed from the glass plate. On applying a strong horse-shoe magnet to the dust, the material was found to be strongly magnetic, thousands of the black, opaque spherules clinging to the magnetic poles. In the material derived from the roof of the car, the spherules range in size from one-fiftieth of an inch, to the most minute in size. In order that the editor of the JOURNAL, may, if deemed desirable, verify my statement, I have forwarded two packets of the material, one from the roof of a car, the other composed of brushings from the French plate glass.

EDITORIAL.

Terrace dust.—The interesting paper on this subject in the March number, page 72, has been replied to by Mr. Cunningham, on page 205 of the present number. The samples which he forwarded we have hastily examined. They bear a striking resemblance to the dust found in Calcutta, but absolute identity of origin cannot be affirmed at present. We shall be glad to receive some "dust" from Calcutta for comparison with that of Mr. Cunningham. We have forwarded the samples submitted by him to Calcutta.

The final assumption would be that the spherules in the dust are "of the earth, earthly," and not of "cosmic origin" as was at first suspected by the Calcutta observer.

MICROSCOPICAL APPARATUS.

Hicks' New Medical Microscope.—Mr. Jas. J. Hicks, of Hatton Garden, whose name is so indelibly stamped on the philosophical instrument industry, had not been long engaged in the construction of fine microscopes before he introduced a pattern which has already made its mark. The "Medical" Microscope is expressly designed to provide doctors with a first class microscope at a low figure. It is fitted with a bright solid foot that enables it to stand with exceptional steadiness, and shaking is reduced to an absolute minimum. It possesses two eye-pieces and two specially-constructed objective glasses, of 1-6 inch and 1-10 inch; a massive circular brass stage, flat and concave mirrors, that are attached to a revolving arm by a very neat motion, which enables the observer to place them in any position to the right or left of the stage and either above or beneath it. The microscope has also coarse and fine adjusting screws, stand condenser, live-cage and a pair of tweezers. The instrument as a whole is exceedingly handsome, and whether placed in the surgery, study, or laboratory, will not fail to attract attention and admiration. It is fitted into a neat polished mahogany cabinet with lock and key. Though designed specially for medical use it is equally appropriate for other pursuits or studies. The retail price of this instrument complete is £12 (\$60).—*The Optician*.

MICROSCOPICAL MANIPULATION.

A Means of Recognizing Frozen Meats.— M. Maljean in the *Archives de Medecine Militaire*, says: This means is based on the aspect of the globules of blood obtained by scraping. In the frozen meats, these globules are colorless, deformed and float in a greenish serum. There is no longer a single one in the normal state. The cold makes the red globules burst; then the coloring matter is extravasated in the serum, where it is found again under the form of irregular crystals colored yellowish brown.

To Open A Rusty Knife.—We are indebted to *The Inventive Age*, for the following article and for the use of the cuts with which to illustrate it.

Take a piece of soft but strong cord, wind it tightly from ten to fifteen times around the closed blades of the knife and of the knife body itself as shown in Fig. 1. Hold or tie the remaining end of the cord to your middle finger. Find a grassy



Fig. 1.



Fig. 2.

spot or soft place and throw the knife down with all your might, just as you do in spinning a top and as shown in Fig. 2. The centrifugal force, caused by the unwinding of the cord and the rapid rotation of the knife will make the blades fly open like the balls on a governor of a steam engine.

BACTERIOLOGY.

Exhibitions of Cholera Bacilli.—Dr. J. H. Gottlieb, Professor of Microscopy in New York Medico-Legal Laboratory, having recently exhibited some cholera bacilli at the American Museum of Natural History, the matter was reported to the Board of Health, and Dr. H. M. Briggs, pathologist to the Board, was asked to make an investigation. On his report, the Board passed a resolution at its meeting, April 26, prohibiting public exhibitions of such bacilli in the future.

The Pasteur Institute.—This institute has been removed from West 10th Street to its new quarters facing Central Park at West 97th Street. The building is a model structure erected expressly for the purposes of the institute. It is six stories in height, and has a frontage of 26 feet on 97th Street, and 100 feet on Central Park. On the first floor are the parlor, reception-room, operating-room, laboratories and the private offices of the director; on the sixth floor are the dining-rooms, kitchen, laundry and servants' apartments. The other floors will be occupied by patients undergoing treatment. On the roof there is a superstructure of iron, where animals used in obtaining virus for inoculations will be kept.—*M. and S. Journal.*

MEDICAL MICROSCOPY.

Medical Aspects of the Borden Case.—The matter of blood-stains so far as an identification of human blood-corpuscles was concerned had a secondary importance in this trial. Numerous weapons were in evidence; but they were all found to be free from blood-stains, although most of them presented spots of rust or other discoloration that at first view were suspicious. The only spot of blood found on the clothing of the accused was a minute dot, not larger than the head of a small pin, situated on the back part of a white underskirt; the corpuscles in this stain showed a micro-metric diameter "consistent with" that of human blood-disks, but also not to be distinguished from the blood of menstruation.—*Boston Med. and Surg. Journal.*

Tuberculosis is very common in domestic fowls, but, strangely they do not ematiate under it as does the human subject.

DIATOMS.

Cultivation of Diatoms.—Dr. L. Macchiati, in a communication to the *Journal de Micrographie*, points out that diatoms are easily cultivated in the nutritive solution used in vegetable physiology, provided that a few drops of silicate of potash be added to the medium. Or, the very water which the diatoms inhabit may be used. This when filtered, and with the addition of a few drops of strong silicate of potash solution, forms an excellent fluid. The medium placed in a watch-glass is then inoculated with a loopful of the water inhabited by the diatoms, and the two fluids having been thoroughly mixed together by stirring, a loopful of the mixture is placed on the surface of a cover-glass; the exact thickness is previously ascertained. To the margin of a cavity of a hollow-ground slide is then applied some vaseline, and this is carefully placed over the cover-glass. The slide, now containing a hanging-drop cultivation, is turned over. In such a drop the diatoms are in an almost natural state, and their development and mode of life may be watched under a power as high as 1-18, though the lens commonly employed by the author is a dry apochromatic with focal distance of 4 mm. and N. A. 0.95. In combination with eye-pieces 6, 12, and 18, magnifications of 372, 750, and 1, 125 were obtained. The best part for observing the diatoms is the edge of the drop, and this should be first centered under a low power.—*English Mechanic*.

MICROSCOPICAL SOCIETIES.

Calcutta, India.

The year 1892.—Number of Members, 81, an increase of 3. Receipts \$200; Expenses \$125; Balance on hand, December 31, \$75. The Fifth Annual Report (7 pp.) was issued in January, 1893. Ten papers were read during 1892, as follows:

By J. Wood-Mason, (1) on the Stridulating organs in one of the Myriapods, (2) an elementary account of the Protozoa.

By W. J. Simmons, (1) on diatoms from Hungary, (2) the eye of *Eristalis tenax*, (3) on Hyaline Spherules found in terracedust.

By Dr. A. Crombie, (1) on Elephantiasis and the relation of that disease to the development of *Filaria sanguinis hominis*, (2) on *Tubercle bacillus*, (3) on *Bacillus crassus sputigenus*.

By Dr. A. Alcock, (1) an account of the methods employed and some of the results obtained in the examination of the Indian Ocean by H. M. S. Investigator.

By T. H. Holland, (1) on micro-chemical analysis of minerals.

The society possesses a library and a collection of slides and apparatus. There are many interesting slides. The meetings are held in the Asiatic Society's room free of charge. Quite a loss was recently sustained in the departure of Dr. W. J. Simpson, for England, he having been one of the most prominent members.

BIOLOGICAL NOTES.

The Ocean Food-Supply.—The food-supply of the ocean consist of a few species of unicellular microscopic plants, and of a few simple protozoa which feed upon them. This supply is inexhaustable and it is the only source of food for all the inhabitants of the ocean, except a few which live upon floating sargassum and the littoral algæ, and the drainage from the land.—*Brooks*.

NEW PUBLICATIONS.

The Microscope; its construction and management, by Dr. Henri Van Heurck. English edition translated by Wynne E. Baxter. London and New York, 1893, pp. 382, figures 250. Royal 8.^o

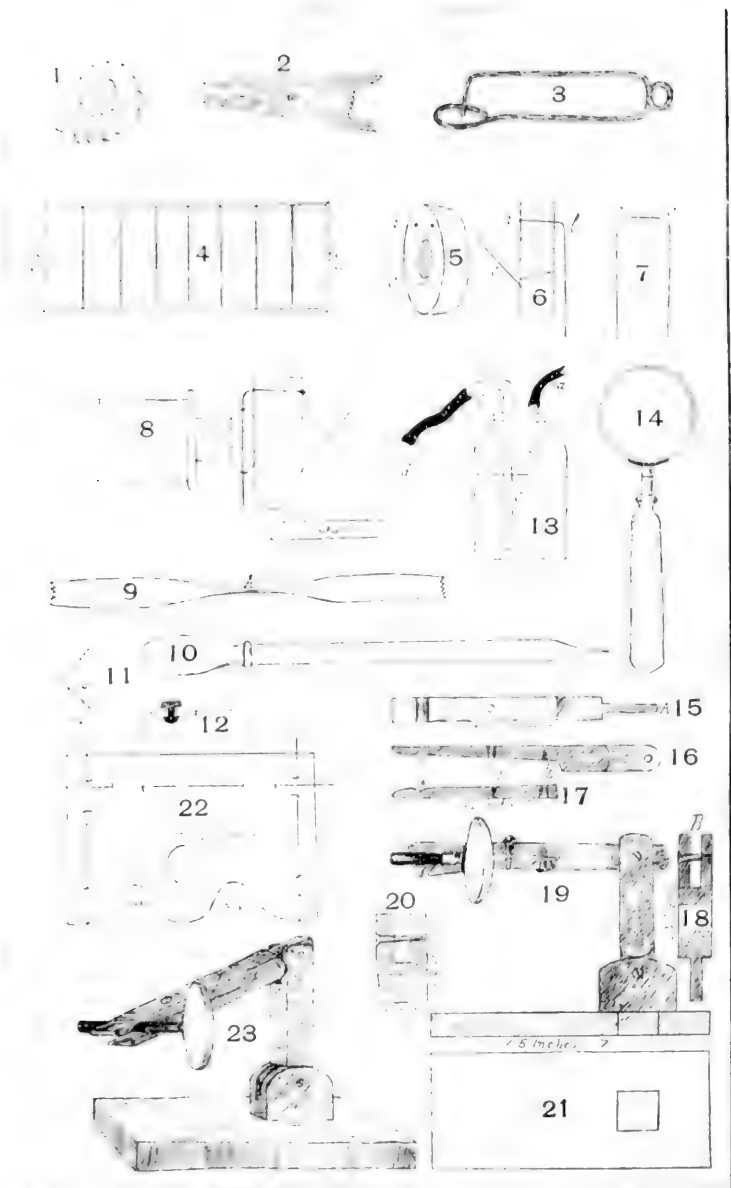
As illustrative of the art of printing, this volume is exquisite; everything about it is superb. But we are especially interested in the subject matter.

Written in French before the Antwerp Exhibition and translated since that event, certain improvements and additions were made in the English edition. That the translator has satisfied the author abundantly appears from the preface by the latter who writes in praise of the work. For Americans then, the English edition alone is desirable.

Coming upon the heels of Dallinger's edition of Carpenter, some will ask for a differentiation between the two. Carpenter covers a broader ground and goes far outside of microscopy proper, into biology, etc., while Van Heurck does not. As describing the instrument itself with variations, probably Van Heurck is superior. Certainly the same ground is covered by both to a great extent and Van Heurck's figures show to much better advantage by reason of the larger pages and heavier paper. Both are guilty of slighting American makers and of utterly ignoring such instruments as Griffith's Microscope, and King's Microtome. Bullock's and Zentmayer's instruments also seem to be entirely overlooked by Mr. Van Heurck. But for the notice of Bausch and Lomb's work, one might suppose the Belgian very ignorant of American skill. The various English and Continental microscopes receive voluminous attention,—nearly 100 pages. These descriptions are all valuable as are those of European accessories. As we keep out all such goods by a protective tariff, it is perhaps but fair that Van Heurck should try to keep a knowledge of American goods out of Europe where his book will circulate most freely. There is great need of a book of this sort by an American author who shall properly present our goods to the world. Will not Ward, Stokes, Tolman, or Seaman undertake it?

In his chapter on the past and future of the microscope, Van Heurck gives an exceedingly interesting treatise, but in "The Microscopist's Library," where he enumerates and recommends some books and periodicals, he has again shown his ignorance or prejudice. For example, he cites the *Journal* of one of our local societies, and makes no allusion at all to the *Transactions* of our National Society. Although we send him our *JOURNAL* regularly, he makes no reference to it. His own book on *Diatoms* is reported, but not Wolle's *Diatomaceæ* of North America. As a book for beginners, he cites Giltay's "Seven Objects observed by the Microscope," but does not notice Dr. Stokes' "Microscopy for Beginners." Although he owns a set of the leading American periodical in which are hundreds of reviews, yet he cites only three American publications in his list,

Taken with all due allowances, the book is still a good one to have and we take much pleasure in commending it to such of our readers as have plenty of money. The price is \$7.00.



SOME HOME-MADE ACCESSORIES.

THE AMERICAN MONTHLY MICROSCOPICAL JOURNAL.

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AUGUST, 1893.

No. 8.

Some Home-made Accessories.

By E. E. MASTERMAN,

NEW LONDON, OHIO,

WITH FRONTISPIECE.

For those who cannot afford expensive apparatus, I will make a few suggestions hoping that some one may profit by them. Of course there are accessories that must be bought, but some others need not be unless one prefers to do so, and this article is intended for those who do not feel able to buy and yet who feel the need of certain accessories.

1.—WATCH GLASSES AND COVERS.

In place of the Syracuse watch crystals or of any others on the market, use the round butter dips made of white earthen ware for staining, soaking, etc. They can, usually, be had at a china store. Use the concave glasses of toy watches, if you can get them. First set them in plaster of Paris which gives a white surface for the bottom. For covers, use tumblers, goblets, or wine glasses which have had the bottoms broken off.

2.—DISSECTING KNIVES AND SCISSORS.

One needs small knives, for dissecting, also scissors and needles. These can sometimes be got from a surgeon in the vicinity, if he happens to have those that are unfit for his use. They are just the thing for our use if properly cleaned and re-sharpened. My first knives were made from common case-knife blades, and were fitted into shape and tempered by a clever blacksmith. I have since paid 75 cents or \$1.00 for some that worked no better.

My scissors consisted of a small pair given me by a milliner. After being re-ground and sharpened, they worked very well.

My needles were common sewing needles fastened into the ends of penny pen-holders. I have since found that there are dentist's tools from which the points get broken and which can be re-shaped and used to good advantage.

3.—ALCOHOL LAMP.

Sometimes an alcohol lamp is wanted. Take a broad-bottomed ink bottle, bore a hole through the cork, insert a brass tube about $1\frac{1}{2}$ inches long. Get some wick and the lamp is complete. An empty cartridge shell will do for a cap.

4.—BOTTLES.

One will need some large-mouthed bottles of different sizes,—1, 2, and 4 ounce are preferred. These can be had at a druggist's for a trifle. If you can afford it, get a few bottles with ground stoppers.

5.—GROUND-GLASS ILLUMINATOR.

Occasionally, it is convenient to have ground glass to place between the light and the object for illumination. Get two square pieces of glass free from specks, flaws or cracks. If two or three inches square, they will be large enough. Also get an ounce or two of fine emery powder. Place one glass on a board, fasten it carefully, and sprinkle on a little emery, moisten with water. Place the other glass upon this and give it a spiral-rotary motion as shown in Figure 1 of the frontispiece. By rinsing with clear water one can tell when it is ground enough. Some excellent pieces of glass can be procured at the photographer's. Get glass upon which the negative has been spoiled and remove the film with hot water.

6.—SPRING CLIPS AND PINS.—FIGURES 2 AND 3.

Pincers are needed with which to hold slides over the lamp. Take spring clothespins (Fig. 2). If they do not fit exactly, correct them with the blade of your knife. These pins should be procured from the grocer or the hardware merchant at ten cents per dozen.

Clips to hold the covers in place until "fixed," may be made by taking wire of the size of a common hair-pin, or larger, and by bending it in the form shown in Fig. 3.

Label each slide you mount, whether temporary or permanent, using plain white paper, one inch square or $1 \times 1\frac{1}{4}$, as suites your taste. Write with black ink.

7.—SLIDE-BOX.—FIGURE 4.

One must have a box or case in which to keep prepared slides. Take cigar boxes, clean them well, paste clean white paper into the sides and bottom of the box. Some may prefer to leave it without paper, thinking the paste or glue with which the paper is glued may draw dampness or mould. I have never had any trouble in that way.

Make trays, in which to place the slides, of such size as that they will slide in and out nicely. Take other cigar boxes and form sides and ends. Cut strips $\frac{1}{4}$ inch or a little less in width. Make sides and ends, and partitions to separate the slides (Fig. 4). Make the partitions $\frac{1}{4}$ inch wider than the slide. Glue on paste-board or card board for bottoms. Put small ears of ribbon on the ends to lift by (*a, a*, in the figure). Make enough trays to fill the box. Keep your slides flat and not edgewise. Many a good slide has been spoiled by being kept edgewise for some time.

8.—CAMERA LUCIDA.—FIGURES 5, 6, 7 AND 8.

If you have no camera lucida, you can easily make one. Take a cork, one inch or more in diameter, and one-half inch in thickness, bore in the center a hole $\frac{3}{8}$ of an inch in diameter, more or less. It need not matter especially, as in Fig. 5. Make two small holes above the large hole, with a small awl. Put them about $\frac{3}{4}$ inch apart (*a*). Bend a small wire or a hair pin, in the shape shown in Fig. 7, the points, *a a*, being the same distance apart as the small holes in the cork. Push the wire through the holes and down, as at *b* in Fig. 6, and about $\frac{1}{2}$ inch from the cork. Make a notch or slit in the cork (*c*), and into this place a nicely cleaned, three-quarter inch, circular cover. Your camera lucida is completed. Slip the wires over the eyepiece so that the hole in the cork comes over the glass, turn the tube down, and it is ready for use.—Figure 8.

9.—GLASS PIPETTS AND BULBS.—FIGURES 9 AND 10.

Glass pipetts are convenient. Take a glass tube, heat it in a hot flame, or have your jeweler do so, then draw it out to a fine thread (Fig. 9).

Break at *A*, and you will have two glass tubes, each with fine points. For a bulb, get a nipple such as is used on nursing bottles. When finished, it will resemble Fig. 10.

10.—A METAL TABLE.—FIGURES 11 AND 12.

One needs a small table, of metal, to heat slides on. Get a piece of heavy sheet iron 3x5 inches or of any other size you wish.

In each corner, make a hole at a point $\frac{1}{2}$ inch from the sides and ends. Cut strips of the same metal of which the table is made to be $\frac{1}{2}$ inch wide and 4 or 5 inches long. Rivet one to each corner of the table (Fig. 11). The figure (12) shows the manner of riveting.

11.—WASH-BOTTLES.—FIGURE 13.

A wash-bottle is a convenience. Get a wide-mouth bottle,—say a quinine bottle. Bore two quarter-inch holes in the cork. Get a glass tube $\frac{1}{2}$ inch in diameter, if you can. If not, one of tin, iron, or brass will do, but glass is to be preferred because more easily kept clean. Also, get two or three feet of $\frac{1}{2}$ inch rubber piping. By studying the illustration, it will be easily understood (Fig. 13). Upon blowing at *a*, the air is forced in to the bottle, and it forces the water out at *b*, through the glass tube, *c*. If the rubber tube *a*, be 2 or 3 feet long and the rubber tube, *b*, the same length, it will be found of greater convenience than by the old way. The bottle can remain on the table. At *b*, there should be a glass nozzle, *d*, like the pippets before described.

12.—CONDENSING LENS.—FIGURE 14.

If you have a burning glass or a reading glass with a handle, you can make a wooden stand that will answer every purpose. Indeed, some prefer them in order to put the money into something that can not be made so easily. Your burning or reading glass may not give as good results as a glass purposely made, but good results can be obtained especially by lamp-light. We will suppose your lens is as shown in Fig. 14.

13.—CONDENSING-LENS STAND.—FIGURES 15—21, 23.

Not all are expected to have nor can afford a complicated arrangement. Some have a very large number of adjustments. Some have as many as twelve motions or twelve adjustments with moving the base. This is very convenient but is costly.

For the base, take a block of hard wood such as oak, maple, etc. Cut it $\frac{1}{2}$ inches thick, $2\frac{1}{2}$ wide and 5 long. Cut a hole $1\frac{1}{2}$ inches from one end and in the center (Fig. 21), make it either

round or square. Cut a piece as shown in Fig. 20. Make a mortice at one end, fit and glue the mortice into the hole as in Fig. 21, the slit being lengthwise of the base. Make a piece like that shown in Fig. 18. Fasten the lower end into Fig. 20 with a screw. If made accurately, it will be firm yet move as a hinge when desired. Tighten it with the screw. Make a piece like that illustrated in figures 15 and 16. The tenon A is to fit in the slit B of Fig. 18 as before described. With a screw fasten A to B. Make a piece as per Fig. 17. The holes, *c*, and *d*, are for a set-screw with which to tighten. The grooves, *e*, and *f*, are for the handle of the glass. Fig. 19 will give a fair idea of the completed apparatus. The joint gives plenty of motion and the glass can be placed at any angle. With these motions and by moving the base about, the light can be brought where most desired.

14.—EYE-PROTECTOR.—FIGURE 22.

Do not shut the eye which you do not use in making observations with monocular microscope, neither squint nor press it with your fingers. By continually doing so, one will be very likely to injure the eye, as I know by experience. It produces astigmatism. A word from one who has had a sad experience should be sufficient. Buy or make a protector for the purpose and save your eyes (Fig. 22).

Take a piece of card board, 5x7 inches. Shape it as in Figure 22. Cut a hole in the center near the lower edge, the size of your eye-piece. Make notches in the lower edge to fit the nose. If the card is not of sufficient stiffness, insert knitting needles at the points shown in the illustration. Make two places for the nose. You may want to use both eyes. Place this card on the eye-piece before inserting it in the microscope, keeping both eyes open.

There are a great many other things that one can make with pleasure and with profit in these hard times, to use while waiting for better apparatus.

15.—ADVICE FOR BEGINNERS.

When through with the microscope, always put it in its case and the objectives in their boxes. If dust gets upon it, remove it with a camel's hair brush, and afterwards wipe with a chamois skin lengthwise of the grain of the finish. Use no alcohol nor chloroform on the lacquered parts. If any part needs oiling,

use clock oil. Never take hold of the tube to move it, always grasp the arm. If out of repair send directly to the manufacturer or to a place where such work is specially done. Do not let any one work upon it who knows nothing about such work. Keep your objectives from direct sunlight and sudden or extreme change of temperature. Have plenty of old, white linen ready for cleaning and wiping slides, lenses, etc. Keep it in a dust-proof box and near at hand.

Make drawings of every thing not permanently mounted. Use the camera lucida, and if you are clever with colors, color them, using water colors. Take notes of everything examined. Let the notes accompany the drawing. Get a plain unruled book for the purpose. Get a drawing book if you can. Some use very fine pointed or very hard pencils for the drawings and trace with ink afterwards.

Take a microscopical journal—two or three, if you can afford it. Also get books. I will name a few from which I have derived much good. If you are a beginner, by all means get *Microscopy for Amateurs* by T. C. White; *Manipulation of the Microscope* by Bausch; *How to use a Microscope* by Phin; *On Mounting Microscopic objects*, by Davies. These can be had from the Microscopical Publishing Company, Washington, D. C. There is a small journal that every one can take. It costs only, \$1.00 per year—*The Microscope*. *The American Monthly Microscopical Journal* is highly recommended and is within reach of nearly all. Address Microscopical Publishing Company, Washington, D. C. Send to all those who advertise in these periodicals for catalogues. Many hints can be had from them, and the advantages of clearance sales.

Flower Crystals of Sugar.—Prepare two test tubes of saturated solution of sugar; one of alcohol, the other of water. Then mix the two solutions in a third test-tube, and when thoroughly mixed, place a drop in the center of a slide and let it rest until it becomes a hard homogeneous mass. Then set this slide, thus prepared, on the top of a student's lamp shade. In the course of a short time, the flower crystals begin to develope. Leave the slide in that position until crystals have developed over the whole mass. The crystals are now very hard and permanent and may be mounted. View it with the polariscope.

Microscopy at the Columbian Exhibition.

By HENRY L. TOLMAN,

CHICAGO, ILL.

The display of microscopes and accessories at the World's Fair, though so scattered as to be difficult to see without considerable trouble, is probably the largest ever made at any exposition, and well worth all the trouble necessary to find it. The displays are scattered among the American, English, French, German and Italian exhibits, most of them being in the great Liberal Arts building. The American displays of scientific instruments are in the North gallery of this building, and the finest show of microscopes is that of the Bausch & Lomb Optical Company. They have a good place in section E, and display 40 microscopes, microtomes and magnifying glasses, besides sterilizers, and numerous specimens of prisms, condensers and photographic lenses. Their newest form of microscope stand is an imitation of the well-known German horse-shoe model, which seems to be liked very much notwithstanding its inherent awkwardness. Another style which they have begun to make is the Wenham radial, which seems to have some striking advantages, though it is slow in coming into popularity.

Next to the B. & L. Co., is the Gundlach Optical Company, with an excellent assortment of lenses, and a collection of stands on the German model. A little to the west is the McIntosh Optical Company, with a good selection of the lower-priced grade of instruments. Near them is the booth of Queen & Co., with their well-known style of stands, and also some specimens of Carl Reichert of Vienna, for whom they are American agents. The house of E. B. Myrowitz of New York, who manufactures the handsome form of stand made popular by the late W. H. Bulloch, is represented by three excellent specimens, which are displayed in the exhibit of the section of Microscopy of the Chicago Academy of Sciences. Among microscope makers, Joseph Zentmayer of Philadelphia, one of the oldest and best-known men of his line, is unfortunately not represented. Grunow and McAllister, once so well-known are also absent, but for better reason, as they no longer make either instruments or objectives. Of objective makers, Spencer and Wales are both conspicuous for their absence, so that, there is a serious gap in the list of

microscope makers of the country which ought to be best represented.

Of English makers, three are represented: Beck & Beck, W. Watson & Sons, and Ross. The first named has the largest exhibit and makes a really fine display, adhering in all material points to the styles so long known. Watson's exhibit is smaller, but he has a novelty, the Van Heurek pattern, which combines a number of conveniences, and partakes more of the English of the than German model. Ross only shows three instruments of the well-known Ross-Jackson model of stand.

In the French department, Nachet makes by far the best showing, but his exhibit is scarcely worthy of him. He makes fine stands and accessories, and they were worthily shown at the Paris Photographic Convention last September, but here the large photo-micrographic camera is absent, and its place is supplied by a small and ill constructed one. The stands are badly arranged and the objectives are limited to a single series shut up in a case. There are, however, a few novelties, one being a stand with a stage nearly 6 by 9 inches, for examination of sections across a whole brain and the like, and another being specimens of "palladiumized" stand or of brass plated with palladium. They resemble oxidized brass and give a fine effect. Vion Freres have a large number of cheap stands, Teigne and Moreau show a few of the conventional forms, and J. Duboseq, the well-known instrument maker, exhibits a fine vertical and projecting microscope.

Italy also appears in the list with a case of stands and objectives manufactured by F. Koristka of Milan. The objectives include an apochromatic of 2 mm. of 140 N. A. but both lenses and stands are a close and servile imitation of German patterns.

But by far the most scientific display of microscopes and accessories of all kinds at the Fair, is that of the famous Zeiss establishment of Jena. It is located in the Northwest portion of the gallery in the Electricity Building with the exhibit of the German Society for Mechanics and Optics of Berlin, the society not being able to get the necessary space in the Liberal Arts Buildings. There seems to be something of the proverbial "yankee" energy and push in the way the Zeiss business is conducted, and it is shown in the exhibit. Every kind of instrument made by the firm is to be seen here, from the simplest

hand lens to the most complex outfit for photo-micrography and complete sets of achromatic and apochromatic objectives.

In the way of stands there is nothing specially new, which has not been exhibited for several years, but there are some novelties in accessories. One is a mechanical stage, square in form, attached to the main stem of the instrument and removed by unscrewing a screw and raising a bar. It could be easily attached to almost any instrument and ought to offer a good hint to American makers. The photo-micrographic apparatus is very complete, and has many peculiarities. The tube of the microscope is very wide (50 millimeters) and only three inches long, but has of course a draw tube. The camera is designed to be used with electric light, and a beautifully designed lamp for the arc light is attached. The whole apparatus with achromatic condenser, monochromatic light attachment, centering apparatus, stand, camera, etc., costs \$500 in Germany or \$750 with duty and freight paid. There are other interesting specimens in the exhibit, such as the micro-spectroscope, the micro-spectral photometer for quantitative micro-spectrum analysis, the micro-spectral objective for observing and measuring the effects of the colors of the spectrum on microscopical objects, the spectro-polarizer for determining the character of double refraction in microscopical specimens for particular wave-lengths and the refractometer for determining the refractive index of glass and liquids.

F. W. Schieck of Berlin, one of the oldest microscope makers in Europe, makes a neat exhibit of cheap instruments, two of them being of an old pattern, rarely seen at present. One of these is designed to have the specimens mounted on a large circular glass which are successively seen by revolving the glass. This form is sometimes used for class demonstration. In the other instrument, the objects are mounted in the rim of a brass barrel, which is turned around for each specimen to be shown.

F. Leitz of Wetzlar, has a fair exhibit of his stands under the charge of his American agents, Richards & Co. It is located in the south end of the Mines and Mining Building, but the exhibit is not in a place where it can be seen to advantage. He has also a few instruments in the German Educational Exhibit, where Hartnack of Potsdam, Siebert of Wetzlar, and a few other minor makers are also represented. The only foreign makers

of note who do not exhibit are Crouch and Swift of London, and Klonne and Mueller of Berlin, so that the foreign representation as a whole is very complete.

In order to bring together microscopists and microscopes, and promote discussion and acquaintance, the members of the section of microscopy of the Chicago Academy of Sciences, formerly the Illinois State Microscopical Society, have made an exhibit, where they have on exhibition not only specimens of the leading kinds of microscopes, but a large number of mounted objects and photo-micrographs made by their members. Demonstrations of methods of mounting, and instruction in the use of the microscope and testing of lenses are given every other day by experts, and the exhibit which is in section E of the North gallery of the Liberal Arts Building next to the Bausch and Lomb display, is designed for headquarters for all interested in microscopy, when attending the Fair.

Diatoms.—H. L. Smith, LL. D., of Hobart College, our best known authority on diatomaceae has sold to Dr. F. E. Hodges, F. R. M. S., of Indianapolis, Ind., his entire library on that subject, his collection of thousands of valuable slides, more than 4000 bottles of cleaned diatoms; also, all of the large collection of diatomaceous earths without making any reserve.

A Method of Mounting Perithecia of Erysiphe.—Remove the perithecia with a spatula and place them in the center of the slide. Cover them with hydrate of potash and let them soak for a few minutes. Then press them with a cover-glass and partially squeeze out the asci. Wash out the potash solution with a few drops of alcohol. Then flood with eosin. Wash out the eosin with sufficient alcohol. Then mount in benzole balsam. You will have a beautiful slide showing aneceptacles, asci and spores. The spores will take the deepest stain and will stand out prominently.

How to Produce Pretty Crystals of Borax.—Make a saturated aqueous solution of borax. Place a drop of this solution on the center of the slide. Set the slide on a window-sill where the draft will affect the slide. Let the preparation stand until the mass is crystalized. Beautiful crystals suitable for an inch objective will be formed.

Classification of the Radiolaria.

By REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

In a former paper, (see this JOURNAL for 1892), I gave a classification of the 42 genera found by Ehrenberg in the Barbadoes deposit as arranged by Haeckel. That seemed a fairly large number of genera for the student to make himself acquainted with, but it proves to be child's play in comparison with what he must do to master these Barbadoes forms alone. For, instead of 42, I find there are no less than 191 genera now known to exist in that deposit or almost five times as many as we considered. And here let me point out the richness of this Barbadoes earth, in other words, how remarkably representative it is of all the fossil forms.

The Radiolaria are divided by Haeckel into four legions, namely,—

SPUMELLARIA, (or Peripylæa,)

ACANTHARIA, (or Actipylæa,)

NASSELLARIA, (or Monopylæa,)

PHLEODARIA, (or Cannopylæa.)

Now, "of these four legions," he says, the "ACANTHARIA, (on account of the solubility of their skeletons,) have entirely vanished and have never been found fossil. Of the PHLEODARIA, whose silicate skeleton is not, as a rule, capable of fossilization, only one section (*Dictyochida*), of a single family (CANNORHAPHIDA) has been observed fossil. Hence the fossil remains of the Radiolaria belong almost exclusively to the two legions, SPUMELLARIA and NASSELLARIA, which were formerly united under the term "POLYCYSTINA." *

Now, the total number of genera described by Haeckel in the Challenger Report, is 739. But, of these, 168 have only been observed in the living condition. Hence the number of fossil genera is 571. And of these, 191 genera, or fully one-third, have been found in the Barbadoes deposit alone. But even that does not tell the whole story. In the legion SPUMELLARIA, all the 5 families of Sphæroidea are represented; all the 7 families of Prunoidea; and 4 out of the 6 families of Discoidea. So that though there are no representatives of the 9 families of

* Challenger Report, Vol. 18, p. civ.

Larcoidea, yet 16 of the 27 families of this legion are represented, and these 16 families include no less than 226 of the 297 genera belonging to this legion. Again, in the legion NASSELLARIA, all of the 4 families of Stephoidea are represented, 3 of the 4 families of Spyroidea, all of the 3 families of Botryodea, and all of the 9 families of Cyrtoidea. Of the 20 families of this legion, therefore, no less than 19 are represented and these 19 families include 250 of the 274 genera of NASSELLARIA. One-third of all the genera and 35 of the 47 families, of both legions, under which are included 476 of the 571 genera. What more could any student ask than that? Is there another deposit in the world of any kind so rich as that? Instead of having to secure material from a score of localities, all one needs to do is to get some of this Barbadoes earth in order to gain a very comprehensive idea of the fossil forms of this magnificent class, "the very nicest of all the Protozoa," as Haeckel himself wrote not long since. Add to this the ease of manipulation, for that earth is just the nicest sort of material to clean—and, finally, consider that the classification of these forms has been worked out and the whole subject brought well up to date (1887), and I think all will agree with me that there could hardly be a more satisfactory study for an amateur to settle upon. It seems almost too bad that the discovery, description, and classification of these forms of Barbadoes, which belong to the New World, should have been left to naturalists of the Old World. Not that we grudge them one iota of the honor but that we ought not to have left it to them to tell us about our own treasures. But now that they have brought them to our notice, it will be little less than a crying shame if we neglect them in the future, as they have been neglected in the past in this country. Nearly half a century ago, Robert Schomburg discovered this "richest of all the important Radiolarian deposits." As far back as 1847, Ehrenberg described no less than 282 species from it, and, in 1854 published figures of some 33 species. In 1860 and 1861, Mrs. Bury discovered no less than 141 species more, which had been entirely overlooked by Ehrenberg, and took the pains to draw them herself; and, in 1862 these forms were photographed from the original drawings by Messrs. Negretti and Zambra, and the atlas given to the world. In 1873, Ehrenberg published descriptions of 265 species, and in 1875, he put forth a work

with thirty plates on which 282 species were figured and named. In 1882, Butschli added considerably to the number of known Radiolaria from Barbadoes both by figures and descriptions. And, finally, in 1887, Haeckel in his famous Challenger Report, Vol. XVIII, brought the entire literature of the Radiolaria up to the year 1884, including a description of all the Radiolaria that have ever been found in the Barbadoes deposit.*

Meanwhile what have we been doing in this department as regards the Barbadoes deposit? Nothing, absolutely nothing. Not only have we failed to add a single species to those described by naturalists abroad, but we have not even availed ourselves of the results of work of these investigators in order to make a study of these forms on our own account. Instead, we have contented ourselves with a peep now and then at a slide of Polycystina viewed as an opaque object through a half-inch. Here is a magnificent deposit, with nearly 200 genera of the most wonderful and beautiful forms, about which the microscopist in this country is profoundly ignorant. Are the Germans and the English to do all our work for us, and we Americans never to lend a hand or even show any appreciation of their labors? Is it not about time that some of our younger men at least, who have not become absorbed in any special subject, should turn their attention to this, seeing that the material is at command and the deposit lies right at our own door?

But, one may say that the work of Haeckel is costly and inaccessible to the ordinary student. Well, so it is, and it is also very voluminous, including all the living as well as the fossil forms and the whole immense material of the Challenger expedition, and that is why I determined to try to reduce the classification to the simplest possible form, taking only so much as was necessary to distinguish these genera of Barbadoes, and making it as easy as possible for the student, in order that he may have a concise guide to the study of these forms so far as the genera are concerned.

My first attempt, while tolerably correct, as far as it went, will no longer suffice, as the number of the genera proves to be much greater than I had supposed when I wrote it. It only dealt with the 42 genera of Ehrenberg, whereas, I propose now to give the classification of the 191 genera as described by Haeckel,

* See Challenger Report, Vol. 18, Preface and Introduction.

all of which, remember, are to be found in the Barbadoes deposit. But these 191 genera are altogether too much for one article. However, they fall conveniently into two groups in one of which there are 71 genera. Some of these were classified in my first paper, but more were not. I said the Peripykeæ (or Spumellaria) contained 20 genera and I gave the names. Two of those genera I find now are not represented in Barbadoes, namely, *Stauractura* and *Echinactura*. So that of the 71 genera only 18 have been touched upon, in other words 53 will be entirely new. Under these circumstances I think it will be wise to begin all over again.

Let us take then the 71 genera of the SPUMELLARIA, or PERIPYKEÆ, in which the skeleton is round or disk-like and has no large mouth or opening and the central capsule is spherical and has pores distributed all over it.

Now these 71 genera are divided into 3 main groups, thus:

I. *Spharoidæa*—Spherical Shell.

II. *Prunoidæa*—Ellipsoidal Shell.

III.—*Discoïdæa*—Discoidal Shell.

Taking the first in order, we have 21 genera arranged according to the presence or absence of radial spines and the number of spheres.

I.—SPHERICAL FORMS.

1.—Family: LIOSPHERIDA. No radial spines.

A.—ONE SPHERE.

Tubuli.

Ethmosphæra.

None.

Cenosphæra.

B.—TWO SPHERES.

One within capsule.

Carposphæra.

C.—THREE SPHERES.

One shell within capsule.

Rhodosphæra.

Two shells within capsule.

Thecosphæra.

D.—FOUR SPHERES.

Two inner medullary, two outer cortical.

Cromyosphæra.

2.—Family: STYLOSPHERIDA. Two radial spines opposite in one axis.

A.—ONE SPHERE.

Spines equal.

Xiphosphæra.

Spines different.

Xiphostylus.

Spines united by ring. *Saturnalis.*

B.—TWO SPHERES.

Spines equal. *Stylosphaera.*

Spines different. *Sphaerostylus.*

3.—Family: STAUROSPHÆRIDA. Four radial spines forming a cross.

A.—ONE SPHERE.

All four spines equal. *Staurosphaera.*

B.—TWO SPHERES.

All four spines equal. *Staurolonche.*

Four spines different in pairs. *Staurolonchidium.*

C.—THREE SPHERES.

All four spines equal. *Stauracontium.*

4.—Family: CUBOSPHERIDA. Six radial spines opposite in pairs.

A.—TWO SPHERES.

All six spines equal and simple. *Hexalonche.*

B.—THREE SPHERES.

All six spines equal and simple. *Hexacontium.*

5.—Family: ASTROSPHERIDA. Eight to twelve or more radial spines.

A.—ONE SPHERE.

Spines all of same kind and simple. *Acanthosphaera.*

B.—TWO SPHERES.

All spines equal and simple. *Haliomma.*

C.—THREE SPHERES.

Spines equal. *Actinomma.*

Larger and smaller spines. *Echinomma.*

II.—ELLIPSOIDAL SHELLS.

Here are 19 genera which fall into 3 sections according to the number of chambers.

A.—One Chamber.

6.—Family: ELLIPSIDA. One shell.

Radial spines. *Ellipsoidium.*

No radial spines. *Cenellipsis.*

Polar spines. *Ellipsoxiphus.*

Spines at one pole only. *Lithomespilus.*

7.—Family: DRUPPULIDA. Two shells.

A.—MEDULLARY SHELL SINGLE.

Two polar spines equal.

Lithatractus.

Two polar spines unequal.

Druppatractus.

No polar spines.

Prunocarpus.

B.—MEDULLARY SHELL DOUBLE.

Two polar spines equal.

Stylatractus.

Two polar spines unequal.

Xiphatractus.

8.—Family: SPONGURIDA. Spongy shell.

A.—NO INNER SHELL.

No inner latticed medullary shell.

Spongoprimum.

B.—INNER LATTICED MEDULLARY SHELL.

No polar spines.

Spongodruppa.

Two polar spines.

Spongatractus.

C.—MEDULLARY SHELL DOUBLE.

No polar spines.

Spongoliva.

Two polar spines.

Spongoxiphus.

B.—Two Chambers.

9.—Family: ARTISCIDA. One shell.

No solid spines or hollow tubes on poles.

Artiscus.

10.—Family: CYPHINIDA. Two shells, or more.

No polar tubes or spines.

Cypassis.

Two polar tubes.

Cannartidium.

C.—Many Chambers (four or more).

11.—Family: PANARTIDA. Four chambers.

No polar spines or tubes.

Panartus.

12.—Family: ZYGARTIDA. Six chambers, or more.

No polar tubes.

Ommatocampe.

III.—DISCOIDAL SHELLS.

Here are 31 genera which are divided into two main sections according to the number and character of the shells.

A.—An outer lenticular latticed shell, an intracapsular medullary shell, simple or double.

13.—Family: PHACODISCIDA. Margin without chambered girdles.

A.—NO RADIAL SPINES.

Hyaline equatorial girdle.	<i>Periphæna</i> .
No girdle, medullary shell simple.	<i>Sethodiscus</i> .
No girdle, medullary shell double.	<i>Phacodiscus</i> .

B.—TWO RADIAL SPINES.

Medullary shell simple.	<i>Sethostylus</i> .
Medullary shell double.	<i>Phacostylus</i> .

C.—THREE RADIAL SPINES.

Medullary shell simple.	<i>Triactiscus</i> .
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D.—EIGHT RADIAL SPINES.

Medullary shell simple.	<i>Heliosestrum</i> .
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E.—TEN TO TWENTY SPINES OR MORE.

Medullary shell simple.	<i>Heliodiscus</i> .
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14.—Family: COCCODISCIDA. Margin with chambered girdles.

A.—MARGIN WITHOUT APPENDAGES.

Medullary shell simple.	<i>Lithocyclia</i> .
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B.—MARGIN WITH SOLID RADIAL SPINES.

Two opposite spines.	<i>Stylocyclia</i> .
Four crossed spines.	<i>Steuroidiscia</i> .
Five, ten or more spines.	<i>Astrocyclus</i> .

C.—MARGIN WITH HOLLOW RADIAL CHAMBERED ARMS.

Three arms, membrane.	<i>Hymenactura</i> .
Three arms, no membrane.	<i>Trigonactura</i> .
Four arms, in two crossed diameters.	<i>Astractura</i> .
Five arms, at variable distances.	<i>Pentactura</i> .

B.—No lenticular latticed cortical shell. Surface covered by sieve-plates.

15.—Family: PORODISCIDA. Rings round central chamber complete. No open spaces.

A.—NO RADIAL APPENDAGES. NO WIDE OPENINGS.

Equatorial girdle.	<i>Perichlamydidium</i> .
None.	<i>Porodiscus</i> .

B.—NO CHAMBERED ARMS. ONE OR TWO WIDE MARGINAL OPENINGS WITH SPINES.

A single marginal opening.	<i>Ommatodiscus</i> .
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C.—SOLID RADIAL SPINES.

Four crossed spines.	<i>Stauroidictya</i> .
Five or more spines. Equatorial girdle.	<i>Stylochlamydidium</i> .

Five or more spines. No equatorial girdle. *Stylodictya*.

D.—RADIAL CHAMBERED ARMS.

Three arms, regular. *Hymeniastrum*.

Three arms, bilateral. *Euchitonina*.

Four arms, membrane. *Histiastrium*.

Four arms, no membrane. *Stauralastrum*.

Four arms, terminal membranous girdle. *Stephanastrum*.

Five arms. *Pentinastrum*.

16.—Family: SPONGODISCIDA. Spongy. No sieve plates.

Three radial spines. *Spongotropus*.

Five to ten or more. *Stylotrochus*.

None. *Spongodiscus*.

(To be continued.)

Review of "Modern Microscopy : a Hand-book for Beginners by Cross and Cole."

By Dr. W. H. Dallinger,

LONDON, ENGLAND.

[From *Nature*, July 13, 1893.]

This book although only extending to 104 pages, is what it professes to be, and will prove thoroughly useful to beginners. The authors understand practically their respective subjects, and this has given the capacity, never otherwise possessed, to tell the beginner accurately and efficiently what it is needful for him at the outset to know.

It is highly to be commended that they have not rendered their pages incompetent by any pretense at an introduction to the optics of the instrument or concerned themselves with any attempt at exposition of modern optical theory. They have done what affords a more genuine evidence of their appreciation of the importance of these subjects, having presented the results of the study of them in a practical form to the beginner so that although his earlier efforts are not complicated with mathematical demonstrations and theory, he is nevertheless taught to work, on the highest results reached through these, so far at least as they apply to his initial endeavours.

The danger of extremely elementary books on microscopy is shallowness. They have often been a mere catalogue of two or

three chosen instruments, with brief accounts of the apparatus affected by the author, and descriptions of pretty or pleasing objects. The former part of this book is much more than this; it gives the results of a practical knowledge of how to employ the instrument in such a way as to attain the finest results; always remembering that it is beginners that are receiving the instructions.

There are some thoroughly sensible things said on the microscope stand. We may differ slightly from some of these, but they are written with a knowledge of the subject and those who follow them will not greatly err.

We can commend, also the chapter on "Optical Constructions." It is brief, but puts to the beginner exactly what he requires to know. The pages on "Illuminating Apparatus" are specially commendable because thoroughly experimental. In fact, the fifty-five pages devoted to modern microscopy will be a boon to every one of the many who are every year "beginning" with the use of the microscope.

But the practical character of the book is seen even more clearly in the second part of it, by Mr. Martin Cole. He at once introduces the tyro to the art of preparing and mounting his own objects. Here again it is not a mere repetition of what has been obtained from other sources that is presented, but Mr. Cole's long experience as a mounter is given to the reader unostentatiously and with pleasant and useful brevity.

There are some who, glancing at this little treatise, will at once conclude that the thirty-six pages devoted to the subject must leave it inefficiently treated even for beginners. We advise such to read the pages; and after some years of practice in most of the departments of mounting referred to and explained, we can only say that they present in a brief but a very efficient manner the facts required to enable the earliest efforts of an earnest amateur to become so successful as almost certainly to secure his interest in the subject, and cause him to intelligently pursue his pleasure and instruction, if not to aim at scientific work directed by more exhaustive treatises.

Fragile objects.—Soak them in a solution of gum arabic and glycerine (seven parts to one part) so as to toughen them. They can then be handled without breaking.

The Use of Ruthenium Red in Plant Histology.

Translated and Condensed,

By A. B. AUBERT,

ORONSO, ME.

At the meeting of December 26th, 1892, of the French Academy of Sciences, Mr. A. Joly presented a paper upon the ammoniacal compounds of the sesquichloride of ruthenium. Among these compounds is: $\text{Ru}_2 (\text{O H})_2 \text{Cl}_4 (\text{N H}_3)_7 3 \text{H}_2 \text{O}$ which is formed by adding very finely divided anhydrous sesquichloride of ruthenium to a cold solution of ammonia. If this be kept at a temperature of 40° for some time the liquid becomes deep red and when sufficiently concentrated small brown crystals of the above formula separate out. The solution of this compound is red, seen by transparence, but of a violet hue when viewed by reflection. It has such strong tinctorial powers that it may fitly be compared with the organic dyes.

At the meeting of March 20th, 1893, Mr. L. Mangin, presented a paper upon the application of this ruthenium red or oxychloride of ruthenium to vegetable histology.

He says that from its chemical composition and behavior with acids and alkalies it must be looked upon as a basic stain characterized by its inertness as regards cellulosic compounds and its power of staining pectic compounds with varying degrees of intensity.

The stain is not decolorized by alcohol or glycerine and sections stained with it may be dehydrated and mounted in Canada Balsam. It fixes itself energetically upon mucilage derived from pectic compounds, but does not stain that derived from cellulose.

The nitrogenous compounds in plants are unequally stained and always with less energy than pectic derivatives; the nucleus and granular protoplasm stain with varying intensity, the protoplasm staining but slightly. The above results refer more particularly to fresh tissue preserved in alcohol. By treating the sections with alum or neutral acetate of lead the affinity of the nucleus and protoplasm for the stain become more energetic.

To take aniline stain out of cloth.--Dissolve one part of Sodium Nitrate in two parts of dilute sulphuric acid and 75 parts of distilled water. Let it stand over night. Apply gently and rinse carefully.

MICROSCOPICAL APPARATUS.

Proposed Adaptation of Biot's Apparatus to the Microscope.—A. Campbell Stark in a note read at a meeting of the London Chemists Assistants' Association stated that some time ago in order to illustrate the fact that a column of certain kinds of liquids alter the direction of a ray of polarized light, he placed a trough containing turpentine on the stage of a microscope, and by means of the prisms used in polarizing, he was able to demonstrate that fact. This suggested to him that the analyzer and polarizer of the microscope might be used in an adaptation of Biot's apparatus for measuring the circular polarization of liquids.

The proposed apparatus should consists usually of a tube of glass, covered with tin-foil, about 20 centimeters long and closed at each end with parallel glass plates, which can be screwed on and off. This tube fits into that of the microscope, between the stage and eye-piece. The polarizer is placed below the stage, and the analyzer in the position of the eye-piece. Over the analyzer is placed a cap bearing a piece of red glass, so that the emerging light is rendered monochromatic. The microscope is now placed horizontally, and the reflecting mirror moved aside. The flame of a lamp is brought within a few inches of the lower end of the polarizer. The lamp-glass should bear a black spot, which gives the extraordinary image at the other end of the system.

When these have been arranged, the tube of the instrument is moved as close to the polarizer as possible, and one of the prisms is turned so that the extraordinary image disappears, and very little light passes. On filling the tube with an optically active liquid, the extraordinary image and the light reappear, and the prisms must be turned right or left so as to cause the image to vanish. The arrangement carrying the analyzer should be provided with a fixed scale, divided into degrees and furnished with an indicator.

Ordinarily, the whole cost of adapting this contrivance to a good microscope is but a few shillings, and it furnishes means of ascertaining, (1) Whether a liquid is optically active, (2) Whether dextro or lævo-rotatory, (3) The relative optical activity of several liquids.—*Druggists, Circular & Chemical Gazette.*

MICROSCOPICAL MANIPULATION.

New Method of Preparing Dentine.—In this method, suggested by Lepkowski, it is stated that sections of bone or dentine may be simultaneously softened and stained. The agent used is a modified form of Ranvier's fluid, and is composed of six parts of a 1 per cent watery solution of gold chloride to three parts of pure formic acid. The pieces of teeth, which should be $\frac{1}{2}$ to $\frac{3}{4}$ mm. thick, are placed in this fluid for twenty-four hours; they are then removed, washed with distilled water and placed in a mixture of gum arabic and glycerine for twenty-four hours. On removal from this last re-agent, they are again washed with distilled water, then in alcohol, after which they are embedded in celloidin or paraffin.—*Journal British Dental Association.*

To Prevent the Reddening of Canada Balsam.—The tendency of Canada balsam to become red may be checked, and the balsam bleached by the addition to the solution of a few crystals of pure metallic copper, precipitated from copper sulphate solution by any of the ordinary methods. This process originated with the late Allen Y. Moore, of Cleveland, Ohio, and was the result of accident. What the philosophy of it is we do not know, as the copper crystals do not seem to be changed in any manner, even after long immersion in the solution of balsam.—*National Druggist.*

Structure of Bacteria.—Sjöbring has worked with the *Bacillus anthracis*, a hay bacillus, a vibrio, and several forms of cocci. He fixed the preparations by means of nitric acid, with or without alcohol, and stained with carbol-methylen blue or carbol-magenta red, afterwards decolouring with nitric acid and examining in glycerine and water.—*Centr. f. Bakt. u. Parasit.*

Formula for Making Picro-Carmine Stain.—(1) Carmine, 1 gm.; liquor ammonia, 4 ccm.; mix and add 5 grms. picric acid; (2) carmine, 15 grms.; picric acid, concentrated solution. Agitate the mixture (1) from time to time for 2 days, let it settle, decant, and evaporate decanted liquor at ordinary temperature, re-dissolve the dry residue in water, making 1 per cent or 2 per cent solution; filter when necessary. Triturate the carmine in water until very fine, add enough ammonia to dissolve the car-

mine, to this add slowly the concentrated solution of picric acid until the mixture has a blood-red color, keep in a shallow dish until all odor of the ammonia has disappeared, filter, keep in a well stoppered bottle, add a few drops of carbolic acid. Filter before using.—*Jour. British Dental Association.*

BACTERIOLOGY.

The Distribution of the Bacilli of Diphtheria in the human Body.—The opinion has been generally entertained heretofore, that the bacilli of diphtheria were localized in the false membrane characteristic of the disease.

Frosch (*Zeit. f. Hygiene* XIII, 1893, pp. 49) gives the results of his investigation of fifteen fatal cases of diphtheria. In five of these the specific bacteria were not found in the internal organs, in the other ten the diphtheria bacilli were insolated from the blood and various organs. The bacteriological examinations were made as soon as possible after the death of the patient. The ordinary method of making agar plates was employed. In some of the cases, the bacilli were unusually distributed through the body, as indicated by their insolation from the blood, spleen, liver, kidney, cervical and bronchial lymphatic glands, lungs (when hepatized), pericardial and pleuritic effusion, and the brain. In a few cases they appeared in the cultures from the spleen or kidneys only. Babes, Kolisko and Paltauf, and Spronck are the only observers who have made similar observations in the past. The results obtained by Frosch bring out with clearness a very important fact in the pathology of diphtheria.

The Preparation of Haffkine's Anti-Cholera Vaccines.—According to Haffkine's method protection against cholera is brought about by acclimatizing the system first to a weak virus and afterwards to a strong cholera poison. The materials used in bringing about such a condition in the normal body, and the method of preparing the same are described by Wright, in a recent number of the *British Medical Journal* (Feb. 4, 1893). The vaccines consist of emulsions of attenuated and of exalted cholera cultures. They may be of two kinds. An emulsion (1) of the living cholera bacilli (living vaccines), or (2) of cholera bacilli that have been killed by action of diluted carbolic acid

(carbonized vaccines). The living vaccines possess a greater vaccinating power, but the carbonized vaccines have the advantage in being perfectly safe to handle or to leave about. They do not appear to be impaired by keeping, and could be sent out from some central place where they could be made in quantity.

The attenuated cultures are obtained by M. Haffkine by cultivating the cholera bacillus in media which are continually aerated at a temperature of 39° C. When the cholera bacilli have been grown under these unfavorable conditions for some time, they become so weakened that they cause a local oedema instead of necrosis when they are injected into the subcutaneous tissue of a guinea-pig. Attenuated germs can be cultivated indefinitely in agar tubes without regaining any of their lost virulence. The "exalted" vaccines are obtained by growing the cholera bacilli in the peritoneal cavities of a series of guinea-pigs. As each guinea-pig dies the fluid which is found in the peritoneal cavity is inoculated into a second pig and so on until the virus has passed through a series of twenty or thirty animals. During such a long series it is very difficult to avoid contamination of the virus unless the strictest care is exercised.

The cholera bacilli are not sufficiently virulent when isolated from the intestinal discharge of cholera patients.

The emulsions are prepared from the attenuated and "exalted" cholera bacteria, by mixing the surface growth on agar cultures one day old, with sterilized bouillon, two or three ccm. of liquid for each agar culture. The carbonized vaccines are prepared in precisely the same manner as the others but instead of bouillon, a five per cent solution of carbolic acid is used.

In these vaccines there are no living cholera germs. The vaccines are injected beneath the skin with a sterilized hypodermic syringe. The injection of the "exalted" vaccine is made about five days after the injection of the attenuated virus.

MEDICAL MICROSCOPY.

Detection of the Bacillus Tuberculosis.—M. M. Pewsner and Nastinkoff, of the bacteriological laboratory of Professor Afanassieff at the Clinical Institute of the Princess Elena Paulowna, contribute to *Watch* the following process for staining

Bacillus Tuberculi. Prepare a solution of mercury bichloride 1:2000. Shake a portion of this solution in a test-tube along with a few drops of aniline oil, and filter off. To 10 ccm. of this filtrate, add 1 ccm. of a 10 per cent solution in absolute alcohol of gentian violet, methyl violet, or fuchsin. The material to be examined is placed for five minutes in this staining solution, care being taken to keep the watch-glass or other container covered during the immersion. The section, cover-glass preparation, or other material, is then washed in water and is ready for the complimentary stain. For this the reporters recommend a solution of malachite green or eosin in the sublimate solution, first made, 6 cg. of the dry color to 60 gm. sublimate solution. The preparation must be barely dipped into this solution for one or two seconds at the outside. The total tinting ought not to occupy over six minutes, and a person used to doing such work can get the specimen ready in five and half minutes, including washing, etc. The results are everything that can be wished. To show tubercle bacilli in the structures (kidney, lung, etc..) macerate the latter for two days in absolute alcohol. Remove and place in a chloroform solution of paraffin (paraffin, 5 parts, chloroform, 1 part), and keep at a temperature of 55° C. for a half-hour to an hour. Remove, and place in pure melted paraffin and keep in it at a similar temperature for twenty minutes. Embed, in the usual way, in paraffin. Clean the sections first with xylol, then with absolute alcohol, and finally with water. They are now ready for staining, as already detailed. Cover-glass preparations of sputa are fixed in the usual way, by being carried thrice through an alcohol flame. The stained sections can be examined directly with glycerine as a medium or may be prepared by the well-known methods for mounting in balsam. The editor of the *Druggist*, who has hitherto used Glorieux's method for rapid staining, has given the above method a trial, and can confirm that it leaves nothing to be desired in point of sharp, clear coloration of the bacilli. While not quite as rapid as the method of Glorieux, it is far less liable to failure, and is, beside, free from the disagreeable accidents that sometimes occur in the rapid handling of the concentrated phenol solution of methyl blue, both of which leave intense stains on the fingers when the latter come into contact with them.—*National Druggist*.

MICROSCOPICAL SOCIETIES.

San Francisco, Cal., Wm. E. Loy, Secretary.

April 5, 1893. — Emmet Rixford, M. D., was elected a member. The cabinet was increased by the addition of various preparations and specimens, including cane sugar in quince jelly and a section of oolitic marble from Lighton, Omaha; moving bubbles in blue stone, from the Essex County Microscopical Society, fossil diatoms from L. M. King, Santa Rosa; slide of *Shepherdia*, mounted by George Otis Mitchell; diatomaceous earth from St. Peters, Hungary, received from R. Gestheimer, Berlin; turkey liver from Colonel C. Mason Kinne; leaves of *Shepherdia canadensis*, from the Iron City Microscopical Society, Pittsburg.

The library, beside the regular list of periodicals and journals, was augmented by "Manipulation of the Microscope," by Bausch, donated by Charles C. Riedy. A large number of valuable new book was brought to the attention of members, including the "Report of the Challenger Expedition on Foraminifera," "Squire's Methods and Formulae," "Mills' Photography Applied to the Microscope," "Bousfield's Photo-Micrography," "Behrens' Guide to Microscopy in Botany," translated by Hervey; "Wormley's Micro-Chemistry of Poisons," "Black's Formation of Poisons by Micro-Organisms," and "Senn's Surgical Bacteriology."

Douglass W. Montgomery, M. D., delivered an address on *Molluscum contagiosum*, a peculiar cutaneous disease which for years has furnished a topic for microscopical investigation. The disease is not one of painful or fatal issue, and its chief interest lies in the changes observed in epithelial cells during its development. It has also served, by its analogy in growth and development to true cancer, to promote investigation and study of that fatal morbid growth in a new direction, and the speaker predicted that the students of cancer had made the preliminary advance which must lead to such knowledge as will enable physicians to prevent if it may not be possible to cure the disease. Dr. Montgomery has prepared several sections of *Molluscum contagiosum*, which showed perfectly its peculiar development. At the conclusion of the address discussion followed, and some interesting and valuable facts regarding the development of disease germs in the blood corpuscles were elicited.

NEW PUBLICATIONS.

Principles of Zoology. A guide for Beginners, by Richard C. Schiedt, Lancaster, Pa. pp. 310. 12°.

As a condensed statement of the latest researches in Embryology and as a guide to the more general classification of animals, this book will serve an excellent purpose. It will of necessity be somewhat effemeral because every year produces enough new information about animals to make changes in classification necessary. As classification is based upon natural affinities and as the knowledge of these is always defective, classification has been and always will be defective and changing. It is greatly to be regretted that this science must be subject to such changes and it is doubtful whether college students in general should be expected to learn a classification to-day which will change to-morrow and indeed which is not universally accepted even for to-day.

The author calls his book, "a guide for beginners," and we regret not to be able to agree with him. It seems to us that a beginner could make no use at all of the book except under the personal tuition of a thorough biologist, and that even with that assistance, the beginner would fare badly indeed. Its pages fairly teem with technicalities and with scientific names. The author should certainly have appended a glossary of several hundred words. A few hundred small cuts showing types of every order and family would do something to impress upon the student's mind the jargon of Greek and Latin words put before him. Without the glossary and the cuts we fear that the book will drive towards insanity some of the professor's pupils and terribly diminish the number of "beginners" who will seek such a guide. In saying all this, we do not wish to detract a particle from the value of the book to specialists in biology and to students who have already mastered some elementary text-books, and who now wish a book of reference while studying museum specimens. It ought to answer the latter purpose well if the museum is large enough. Our increasing knowledge of biology is rendering more and more difficult the task of comprehending it and calls for new and more elaborate text-books.

DETECTION OF CRIME.

One night, an assassin killed a drover in Ohio, and secured a package containing \$1800. In getting away he hurt his hand and stained the package with blood, after which he threw away the wrapper. Suspicion having rested upon a certain man who was found to be spending money freely, the police followed him and examined every bank note that he parted with, until one was found containing a smear of blood. Examined under a magnifying glass, the streaks of blood on the wrapper were found to correspond exactly with those upon the bank note. It was then proven that the wrapper had been in possession of the murdered man. Upon this evidence the prisoner was convicted and hanged.

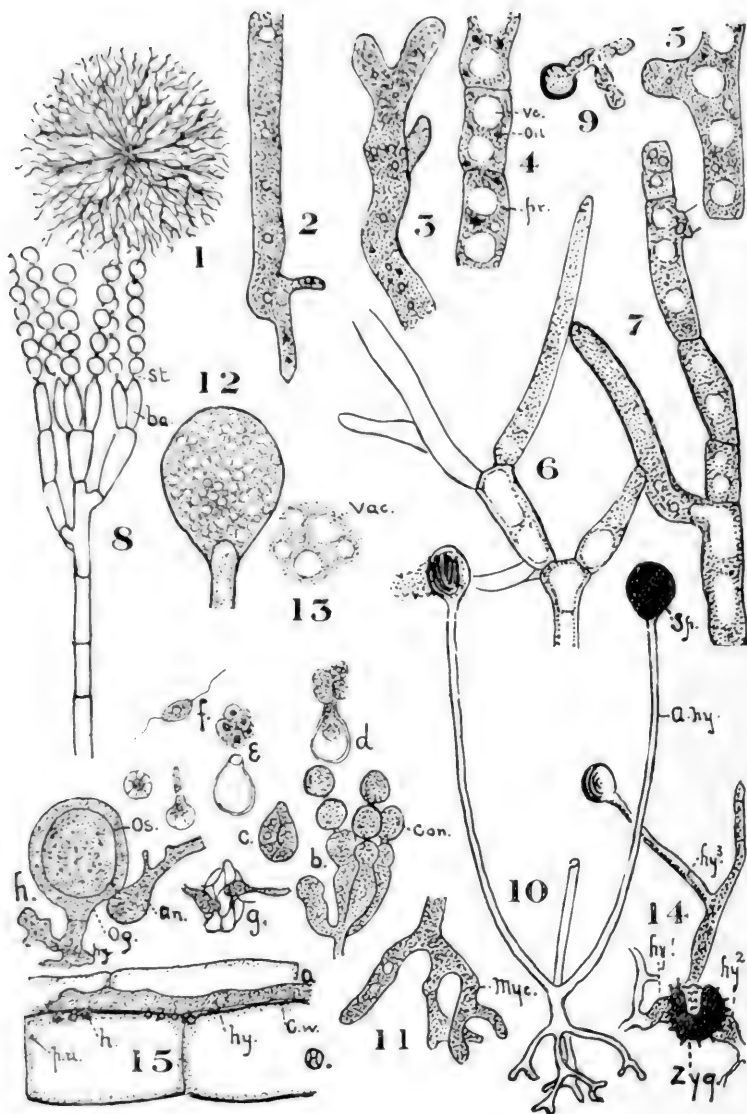
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SUBSCRIPTION PRICES.

The Microscopical Journal.....	\$2.00) Price for Both.....	\$2.50
The Microscope	\$1.00		



PENICILLIUM AND SOME OTHER FUNGI.

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Penicillium and Some Other Fungi.

BY HENRY LESLIE OSBORN,

ST. PAUL, MINN.

WITH FRONTISPIECE.

The study of the fungi is so very easy for any one who is desirous of applying his microscope to the discovery of facts in nature that surely it will be worth while to devote some space to an account of a few of them. Moreover, there are many of them of the utmost practical interest to man, being intimately connected with many of the most necessary of his operations. Thus the baker, the brewer, the dairy-man, are directly at the mercy of fungi. The agriculturist is often hindered in his plans by their growth, while in other cases his plans are helped. The doctor has in many of his patients to contend with the

EXPLANATION OF THE PLATE.

1.—*Penicillium*.

1. The mycelium of a young colony of *Penicillium*,—growth from the spore of about three days.
2. The tip of a submerged hypha. Note the scarcity of vacuoles.
3. Tip of a branching hypha.
4. Lower portion of a submerged hypha, showing vacuoles and the cross-walls.
5. Lower portion of a submerged hypha, showing the lateral branching.
6. Bilateral branching in a submerged hypha.
7. Lateral branch to show its relation to the parent hypha as a prolongation of it.
8. An aerial hypha bearing the basidia (ba), sterigmata (st), and the numerous conidia in rows.
9. A conidium in the act of germinating, showing the young hypha emerging.

2.—*Mucor*.

10. The entire plant-body, showing the mycelium below the unbranched and unicellular aerial hyphae and their terminal sporangia (sp).
11. More enlarged view of the mycelium showing the protoplasm and the vacuoles.
12. A young sporangium showing the protoplasm before spore formation.

13. A more highly magnified view of a part of Fig. 12, showing the greatly vacuolated character of protoplasm.

14. The germinating Zygospor, showing the two conjugating hyphae (hy-1) and (hy-2), and the germinating spore with the third hypha (hy-3).

3.—*Cystopus candidus*.

15. a. The hypha (hy) surrounded by the tissue of the host showing the haustoria (h), the cell-wall of the host cell, the protoplasm of this cell (p. u).
15. b. The conidia on their parent hypha.
15. c. The conidium with its contents dividing.
15. d. The escaping spores of the conidial generation.
15. e. The later stage of the process.
15. f. The motile swarm-spore of *Cystopus*.
15. g. The spores germinating on the stoma of a host plant.
15. h. The sexual reproduction by means of the antheridia (an), and the oogonium (og). The oosphere (os) is shown and the union between the oosphere and the antheridium is indicated.

All these figures are from nature except those of *Cystopus*.

bacterial forms of fungi. These beings are thus almost everywhere for weal or woe, and the scientific modes of living that are coming into vogue are having to recognize them as among the most potent agencies that affect us.

There are many modes of studying these interesting plants, and those who wish to penetrate deeply into them will find many technical guides to assist them. For the direction of such, a partial bibliography of the subject will be appended. For a beginning, however, fungi can be easily cultivated on almost any organic substance which is kept moist and warm enough. Infusions of various sorts, such as: tea, hay, beef, oats, cracker, and other such common stuff, made by heating the substances to boiling and then setting them aside in tumblers covered with glass plates, will in a few days be found to contain moulds and perhaps also infusorial animals. Another mode of culture is by the use of Pasteur's fluid.* This is made of sugar, ammonium tartrate, and traces of sulphur and potassium salts dissolved in water. If this stands in a wide shallow vessel open to the air for a few days, the vessel will be covered with a white film, this will soon become green in spots and then soon thereafter the green will cover the entire surface. The green color is due to the spores which easily become dislodged and then float in the air. From the green matter thus obtained you can cultivate this mould under any conditions you may desire.

1.—*Penicillium glaucum*.

This is the name of the green mould which is so well known in all housekeeping. As far as the naked eye can take one, the mould appears as a felted, green, or white membrane. In the younger stages of the growth, it is in small spots scattered everywhere on the culture fluid; later, these coalesce and their identity is lost. The surface of the older growths has a velvety appearance. This is due to the innumerable "hyphæ," which are minute threads rising above the mat like the "pile" of velvet. If you blow forcibly over the green surface you can see a powdery dust fly off. It is the conidia or spores which are produced on the hyphæ.

*Pasteur's Fluid is made in the proportion:—

Water 4150 parts; cane sugar, 750 parts; ammonium tartrate, 50 parts; potassium phosphate, 10 parts; calcium phosphate, 1 part; magnesium sulphate, 1 part.

Remove on the point of a needle, from the edge of a growing mat, a small particle and mount it in alcohol (to avoid air bubbles), and the examination can then be carried on readily. The plant is made up of fibres interlaced in every direction; these are so long that it is not possible to find both ends and they are generally broken from their inner ends. These fibres are called the "hyphæ." They end in a row of round, bead-like, spheres called "conidia." The hyphæ, which bear the conidia, are called the "aerial hyphæ." These arise into the air from the meshes of "submerged hyphæ" which are spread out in the nutrient fluid and thence absorb food. These are the three parts of the plant body, which is thus a very simple organism.

The aerial hyphæ branch at their tips and these branches, in some cases, branch a second or even a third time. The ultimate branches thus formed are called "basidia" and these produce on little tips called "sterigma" the small spores or "conidia." The latter are thus buds of smaller size and we see in them a very simple device for reproduction. Their minute size fits them for enduring drought and also renders them readily transportable. These spores are produced in a straight row (Fig. 8), the lower one being the youngest. As a result of this, the older ones can be blown away and no harm to the germinating organ results. The number of spores in a row depends on the age and the circumstances of dispersal, in older filaments there may be a dozen or even more in a row. The spores are protoplasmic bodies, but their minute size makes any effort to stain them and thus demonstrate their protoplasmic character less useful than the method of cultivating them.

The conidia will adhere to a needle drawn through the mass and this can then be drawn through a vessel of Pasteur's fluid. The act sows the conidia in the culture medium. In the course of a few days, minute white spots are seen in the fluid. These are the growth from the spores. They can be taken up in a pipette and placed on a slide. Under the low power they are seen to be made up of innumerable threads radiating from a common centre. In Figure 1, a view of this stage is sought to be given. This complex of fibres is the mycelium. They are the nutritive part of the organism, and at the first there is no other part. If you watch the growth of the white spots from day to day, you will see that they increase in diameter and

gradually become faintly greenish in the centre, remaining white on the borders of the growing patches. As the days go by the patches increase and thus grow toward each other finally fusing at their edges and making one continuous layer. The conidia are thus seen to be the agents of dispersal. The spores can be sown in a cell in Pasteur's fluid, and the development watched from day to day.

This is by a process of budding as in the yeast cell. On the surface of the spore a small swelling arises (Fig. 9). This enlarges, it still increases becoming a thread, it is a young hypha. This, besides elongating, soon gives rise to lateral buds and they elongate and in their turn give rise to new hyphae. The plant thus increases rapidly, each hypha becoming the fruitful parent of many equally fruitful daughters. As to the rate of the growth, this can be observed if you will select some very young bud in a rapidly growing plant and keep it under continuous observation for an hour or so. A series of drawings should be made at intervals of every five minutes to show the different stages of growth.

The growing hyphae of *Penicillium* are very interesting for detailed and minute microscopic study. They require to be examined with a power of at least 400 diameters to show the points now to be mentioned. They are bounded by a cell-wall which is composed of a peculiar variety of cellulose. Within this wall can be seen the finely granular protoplasm. In the tips of the hyphae the cell-wall is filled principally with the protoplasm, but in the older parts of the hypha the protoplasm is interrupted with many "vacuoles." These are spaces in the protoplasm filled with water and probably substances in solution. As the most active growth is at the periphery of the circle of the hyphae, these being the younger portions, and as the vacuoles are not so numerous in them we may perhaps conclude that the vacuoles are a device for helping to make bulk without using such an expensive material as protoplasm. This is also the case in the higher plants in which we see the cell often very strongly vacuolated.

The hyphae have several modes of branching. Perhaps the commonest is by lateral buds (Fig. 7), which rapidly enlarge and in their turn produce lateral buds. In other cases the hypha forks so that you cannot say that either branch is the principal

stem (Fig. 7). In still other instances the tip of the hypha is the seat of germinative activity and, as in figure 3, several branches can be seen arising. The hyphæ are in some cases seen to be divided by cross walls into separate cells (Fig. 7), this is not the case in all the hyphæ, and the younger parts are not divided.

The aerial hyphæ are those that bear the conidia. They are best studied on the edges of the growing mass. They are branched sparingly below but at the summit they branch abundantly and so compactly as to form a broom-shaped mass (Fig. 9), in which at first it is hard to recognize the basidia and the rows of conidia which they bear. A little separation of the mass with needles, and gentle tapping on the cover glass, will help to disengage the hyphæ and render their terminations visible. It is easy to realize after seeing the tips of these hyphæ what countless myriads of conidia can be produced from a complete mycelium. There is no other mode of reproduction, commonly, if ever, taking place in *Penicillium*. In this respect, it is worthy of note, as in most fungi, there are provisions for the occurrence of conjugation, a process in which the growth, at least part of the time, arises from buds formed by the junction of two elements, or cells, prior to active development. The process of conjugation will be more fully described under the account of *Mucor*.

In the young submerged hyphæ, it is very easy to make some studies on the application of staining and other reagents to biological specimens. First, place a drop of stain, for instance iodine, on one side of the cover glass. Then draw this under the cover by means of a blotting paper placed on the other side. This is called "irrigation" of the specimen. If you watch the tips of the hyphæ you will see them take up the color of the stain. The same can be seen with any other stain for protoplasm. The protoplasm is thus demonstrated and vacuoles are seen to be empty places surrounded with protoplasm. Any of the aniline stains can be used in the same way. After the tips of the hyphæ are deeply stained, they can be decolorized and the protoplasm dissolved while you watch the process at every step, if you irrigate the same slide with a 2 per cent solution of caustic potash in water.

2.—*Mucor*.

This is another of the commonest of the "Moulds." It grows

on almost any sort of a foundation. On April 18, Tuesday, I set a dry-yeast cake away under a tumbler having first wet the yeast cake. On the following Monday, it was nearly covered with this mould. The plant also grows on pieces of horse-dung if they are kept under glass to insure that they remain moist. Moisture is an indispensable factor in the growth of all fungi. The plant can be recognized by the long gray threads terminated with black spherical spots. I found on a piece of paper that had been standing a year with *Mucor* on it, very pretty growths, from the spots where the spores had fallen on the paper and germinated. The drawing that accompanies this article is from one of these.

In *Mucor*, usually, if the specimen is well nourished, the hyphæ are not divided into cells. This makes the plant out to be a single and very elongate cell. There are in specimens growing in a soft medium, like bread, a few hyphæ spread out below to form a mycelium. We must remember that the mycelium is the part which gets the food in the allotment of labor to the different parts of these plants. This part in our specimen looks like a lot of roots. It was spread out on the paper and from it drew its food so long as the paper remained moist. The aerial hyphæ are not branched. They arise as a single unjointed tube running up to their summit on which they bear the spherical spore-case or "sporangium." The sporangium is a covered case; really, it is a single cell in the interior of which the protoplasm divides up into a multitude of spores. This same result is reached in *Penicillium* very differently. There the hyphæ produce a great many basidia and these then in their turn produce the conidia while here the spores, which are the equivalents of conidia, are produced by the division of the protoplasm of the cell, set apart for that work, at once. In *Penicillium* a great many cells unite to form the aerial hypha; here only one, to form the hypha and another for the sporangium do all this part of the work.

The sporangium is covered with a delicate cover which as the plant grows older becomes elastic and finally bursts allowing the spores to escape. I believe the spores are thrown out with some violence, for the paper on the sides of the vessel was literally peppered with their growth in every part. The interior of the hypha under the high power shows the presence of proto-

plasm, and this is granular and vacuolated but it is not divided by cross walls. The protoplasm however is thought to contain a large number of nuclei as if cell-division had taken place in part.

There is a process which takes place occasionally in *Mucor*. It is called conjugation. A filament of the mycelium, when growing in a moist medium, sometimes meets a second filament of the same or a different plant, of course of the same kind. When this happens the two filaments unite and a swelling takes place at the junction. A cell wall then cuts off the end of each filament, and the two cells thus formed fuse to form one cell. This product of the fusion of the two cells is called a "zygote" (Fig. 14). It has the same power as a spore, that is to say, it is a starting point from which a new plant can be formed. This process of conjugation is the equivalent of the process of "sexual" reproduction in the higher plants. Its precise meaning in *Mucor* cannot be stated except hypothetically. It is not certain that the process of conjugation occurs in *Penicillium* but it is, on analogy of the cases of other fungi, highly probable.

If the methods of study described for *Penicillium* be used for *Mucor*, the hyphæ are found to be filled with granular, somewhat vacuolated protoplasm. This is shown in Fig. 11. The young sporangia can also be examined. They are, as shown in Figs. 12 and 13, filled in an early stage with protoplasm not yet differentiated into spores. The young hyphæ absorb iodine with immense eagerness and are good subjects for the practise of the staining method.

3.—*Cystopus candidus*; or White Rust.

This, in mature state, is a white scale on the surface of stems and leaves of the water-cress, shepherd's purse and other cruciferous plants. The thin papery scales cover the conidia which lie below them on the summits of the hyphæ. Both the forms of moulds already studied are nourished on dead animal or plant bodies. In the case of *Cystopus*, however, we have to do with a true parasite. The mycelium of this plant lives in the inter-cellular spaces of the living cress. We can get a good idea of the plant by following the course of its development. A spore floating in the air must fall on the stoma of a leaf or young portion of the stem. Here it germinates, throwing out its young hypha which grows into the host plant and there spreads out

pushing the cells apart a little and inserting itself farther and farther from the point whence it started. The hyphæ are furnished with minute suctorial organs. These are called "haustoria" (Fig. 15 h). They are globular swellings of the sides of the hypha. They push through the cell-wall and are thus directly surrounded with the living protoplasm of the host. It is through the haustoria that the parasite does the injury which it inflicts, as well as by the presence of the mycelium in any of the organs of the host. An examination of its floral organs will often demonstrate the presence of the mycelium in these delicate and very important parts of the host. The fructifying organs of *Cystopus* are of two sorts. There are first and more commonly the aerial hyphæ and their conidia. These are formed on hyphæ which burst through the sides of the host giving rise to the blisters or scales already referred to. The conidia germinate on the surface of the host, and send down a hypha through the stoma among the intercellular spaces of the host to reach the succulent cells below. The second mode of development is the sexual one. It is a similar mode to the conjugation of *Mucor*. In it, two sorts of cells are formed on hyphæ located among the mycelium. One of these is smaller than the other. It is called the antheridia. It is the male element in the sexual process. The other cell is larger and spherical. This is met in the host tissues by the antheridium and the two fuse as shown in Figure 15. The product of this act is a cell called the oosphere. The oosphere is now said to be "fertilized," and it now develops into motile swarm-spores like those of the conidia in appearance. These require the death and decay of the host to enable them to develop and produce their generation.

4.—Other Fungi.

It is not within the scope of this article to do more than to awaken an interest in these very easily accessible microscopical subjects. It is worth while, however, in closing, to say that these little beings, are from their immense productivity and the power of drawing their sustenance from other animals and plants, capable of being of great service or harm to man. In the case of the fungi, a majority are probably harmful rather than useful. There are the rusts, the moulds, the smuts, which annually do immense harm to crops; then, there is a fungus

which causes a disease of the feet of cattle. One who has seen a mode of fungoid growth can see at a glance how almost impossible it would be to eradicate the mycelium after it had gotten started. In one case, however, the ingenuity of man has turned fungoid plants to account. It is in the case of the chinch-bug. A fungus has been discovered which if it is sown in fields infested with that insect pest will attack the insect and develop rapidly enough to cause the creature's death.

Allied to these fungi, also, are those which cause the decay of fruit, and even the teeth of man are able to supply the proper nutriment of a fungus which causes their decay. The whole immense field of the bacteria lies near by these interesting plants and some citations to it are given in the partial bibliography which follows.

5.—Collateral Reading.

- | | |
|---|--|
| De Bary. Morphology of the Fungi. | Tyndall. Floating Matter in the Air. |
| Cooke. Fungi. International Scientific Series. | Sternberg. Bacteriology. |
| Huxley and Martin. Practical Biology. | Strausberger. Practical Botany. |
| Howes. Atlas of Biology, plate XIX. | Prudden. Dust and its Dangers. |
| Ann. Rep. U. S. Dep. Agriculture, 1887, p. 323. | Klein. Micro-organisms and Disease. |
| Ann. Rep. U. S. Dep. Agriculture, 1884, p. 212. | Schutzenberger. Fermentation. |
| Carpenter. The Microscope, p. 562. | Truessart. Microbes, Moulds and Ferments. |
| Encyclopedia Britannica. "Fungi," "Schizomycetes." | In addition to the above, see also the text-books of Botany, such as Bessey's Botany, Sach's, old edition and other standard text-books. |
| Biological Laboratory of Hamline University,
St. Paul, Minn., August 29th, 1893. | |

Fragile objects.—Soak them in a solution of gum arabic and glycerine (seven parts to one part) so as to toughen them; you can then handle them without breaking.

Prices of Drugs.—The average price of drugs is $3\frac{1}{2}$ times as much in the United States as in Denmark. What costs 75 cents in New York can be bought in Copenhagen for 20 cents. In Norway, Sweden, Belgium, Germany, Austria, Holland, Hungary, Switzerland, and Portugal, the prices of drugs average less than half what they average in the United States.

Microscopical Technique Applied To Histology.—III.

[FROM THE FRENCH OF RENE BONEVAL.]

(Continued from page 80.)

METHODS OF EXAMINING MEMBRANOUS OBJECTS.

There are no more instructive preparations than those of membranous objects after fixing and staining.

1. **Fixation in the Normal Position.**—The best way is to fix the membranes without disarranging them from the position occupied during the life of the animal. Unfortunately this is applicable to only a very limited number of cases. Use a fixing reagent that acts very rapidly and produces no contraction. Pieric acid and bichloride of mercury may be selected, but osmic acid is preferable, and, whenever possible, as vapor, otherwise in a one per cent solution. The time of action varies from 2 to 10 minutes. . . . Remove a small piece, wash for 20 minutes, stain in picro carmine, or with hamatoxylin and eosine.

2. **By Partial Drying** (Ranvier's method).—Extend the membrane upon a glass plate by the fingers applied at the margins. While it is moist, it will contract the moment it is left to itself, but when beginning to dry (and on account of the heat of the fingers it tends to dry quicker at the edges), its margins adhere to the glass, and by extending it on all sides it may be completely spread out. Fix by absolute alcohol or by pieric or osmic acid. Wash and stain.

3. **Membranes Forming Close Cavities.**— . . . With a syringe inject the fixative (alcohol or pieric or osmic acid) into the cavity. Tie it beyond the canula and put the distended membrane into the fixing solution. In a few hours the fixation is perfect: cut the membrane, wash, stain. The lungs, the bladder and the digestive canal of batrachians should be treated in this way.

METHOD OF DISSOCIATION.

When we have learned the arrangement of the elements by sectioning, we cannot often positively observe the form of the cells or their intimate connections. Then we have recourse to dissociation, that is, to processes permitting the isolating of the elements from one another. The instruments needed are curved scissors, straight needles, two fine forceps, a plate of glass with strips of black, white, green, and red paper beneath

it, over which objects are placed, while over the black paper, etc., the object of course being on a slide. . . .

Ranvier's One-third Alcohol.—(1 part alcohol 36° and 2 parts distilled water), is a dissociation liquid of the first order. Tissues rich in cells are dissociated in it in 24 hours. The fixing and staining of the elements are then readily accomplished.

Iodised Serum.—Next to dilute alcohol iodised serum is most important. [This is made of the amniotic fluid of the sheep or other animal and treated with iodine. It should be made in large quantity in a laboratory, and is omitted here as probably beyond the reach of those for whom these instructions are intended].

Caustic Potassa.—In a strong solution (40 per cent), this is excellent, but the preparations can not be preserved nor stained. Keep the bottle corked with a rubber stopper. The solution is allowed to act on the object while on the slide. To separate the elements it is often only necessary to press slightly on the cover glass.

Chromic Acid.—This is used in weak solution (1 to 5,000 of water). Tissues should remain in it for 2 or 3 days. . . .

Dissociation by Partial Drying.—Place the tissue on a glass plate, without liquid, and when partly dry, without being adherent to the glass, divide it quickly with needles. If the tissue is rich in cells, like the the marrow of bones, excellent dissociation may be had by little blows of the side of the scalpel blade. Harden by osmic acid vapor, stain by picro-carminé, and mount in glycerine. An indispensable condition is to operate rapidly, before the drying is too far advanced.

Dissociation in Liquid.—After a sojourn in the diluted alcohol or in iodised serum, dissociation of the tissue is easy. By curved scissors cut off a small piece and place it on the slide in a drop of the dissociating liquid. A slight agitation by the forceps will free the cells. Add a drop of picro-carminé to the dilute alcohol, mixing them with a needle, and add the thin cover. . . . Allow a drop of glycerine to run under.

The following also gives good results:—Put a piece of tissue in a glass tube with 10 c. c., of the $\frac{1}{3}$ alcohol. In 24 hours, shake violently, and pour out the liquid with the separated cells, and add picro-carminé. Let it settle for 24 hours. When the cells have fallen to the bottom pour off most of the fluid, draw up with

a pipette the separated and stained cells, put a drop on the slide, and apply the thin cover carefully.

For filamentous tissues, the foregoing should be modified. The best method is to dissociate by fine forceps. A piece of tissue being placed in the dissociating liquid, the ends of a filamentous fascicle are seized by forceps and slowly torn in two. This is repeated on the pieces obtained until we have a small bundle containing a few filaments. Mount on the slide; stain and cover.

Dissociation by Interstitial Injection.—(Ranvier method). Fill a hypodermic syringe with the liquid, either osmic acid (1 part to 1000), the $\frac{1}{2}$ alcohol, or iodised serum. Pierce the organ with the canula and force in the injection. If the tissue is compact, separation is finished by needles or by forceps, in a small quantity of the fluid used; if the tissue is loose, like subcutaneous tissue, the injection will form a rounded swelling. With curved scissors cut off a bit of the enlargement and add the thin cover. The movements should be rapid, or the liquid will flow away, the elements become scattered, and the injection will have produced no useful effect (Ranvier). . . . This is the preferable method for studying loose connective tissue.

PART II.—APPLIED TECHNIQUE.

Loose Connective Tissue.—The best is the subcutaneous cellular tissue. Remove a large piece of skin, preferably from the fold at the groin where the subcutaneous layer is abundant, and place the subcutaneous layer upward, taking care not to entangle hairs in it, and with a hypodermic syringe gently inject picro-carminic into the tissue. It forms a rosy swelling . . . of gelatinous consistence. With curved scissors cut off a slice and discard it. Cut from the freshly reddened tissue a second piece as small as possible, rapidly put it on the slide, add a little picro-carminic, cover and examine. The subcutaneous tissue of the dog is well adapted to this.

Connective Tissue Bundles.—The foregoing preparation will show these and the elastic fibres. In 2 or 3 hours it will be strongly colored; . . . then run under the cover a drop of glycerine with 1 per cent of acetic acid. The connective tissue bundles will swell, be decolorized and here and there show Heule's spiral fibres stained red.

Cells.—This method is insufficient for the study of the connective tissue cells. Beautiful preparations of the anastomosing prolongations of the cells may be made by injecting, as described, a mixture of 1 per cent solution of eosin in the $\frac{1}{2}$ alcohol. Place a small piece on a slide, add a drop of glycerine slightly tinged with eosin, and subject it to gentle pressure with a needle. It should be examined with a wide angled objective.

In the connective tissue which forms the frame-work of organs, besides the foregoing flat cells, there are special elements called by Erlich granulation cells or plasmatic cells. To observe these proceed thus. The tongue of the frog (where the cells are abundant), the epithelium being scraped off, is put in strong, alcohol for 24 hours, after spreading it out on a piece of glass. Then transfer to the following, for 24 hours: Absolute alcohol, 50 c. c.; glacial acetic acid, 12 grms., ; distilled water 100 grms.; dahlia, enough almost to saturate the solution. Wash in alcohol for a few minutes and mount in balsam. All the elements are colorless except Erlich's cells whose protoplasm is stained an intense violet white, the nucleus is not colored.

The elastic fibres in the connective tissue of organs may be studied in sections of the skin. . . A section, strongly colored on the slide by eosin in alcohol or in water, is treated by a 40 per cent solution of caustic potash. Cover and examine in the potash solution. The elastic fibres alone keep the rose color. . .

ADIPOSE TISSUE.

After an injection into the subcutaneous tissue of nitrate of silver, 1 part to water 1000 parts, we take shreds of tissue in which to study the constituent elements of the adipose cells. The membrane surrounding the nucleus, the protoplasm and the fat are very apparent. . . . To dissociate the adipose tissue, place pieces of it to soak in ether. In an hour or two the fat will be dissolved, and the membranes enveloping the vesicles can be seen fallen together and wrinkled so that their presence can be readily proved. . . . In these tissues after death, we find, at the center of each vesicle, not a liquid drop, as in life, but a collection of crystalline needles imperfectly rosette-shaped, and these appear to be crystals of margarine. . . .

Osmic acid and quinoline blue should be used as stains. Osmic acid colors fat a deep brown, black if the action is prolonged. This is characteristic. Fat cells in the marrow of

bones are excellent for the study of this reaction. With the point of a scalpel, remove a small quantity, spread it on a cover glass, and without allowing it to dry, separate the cells by gentle blows with the side of the blade. The cells on the plate are then held over a wide mouthed bottle containing 1 or 2 c. c., of osmic acid. After 10 or 15 minutes, mount in glycerine and the coloring will be more conspicuous as the cells are more completely separated. Having become familiar with this reaction, fat cells may be recognized in sections treated with this acid.

Staining with quinoline blue is more elegant and more difficult. Add a few drops of a concentrated alcoholic solution to a small vessel of water. Leave sections there till they are of a deep blue, wash rapidly and mount in glycerine. At the end of 24 hours the nuclei will be decolorized, the protoplasm a clear blue, the drops of fat appearing as intensely blue granules. This color selection may be immediately produced by 40 per cent potash solution (Ranvier).

This connection of fat cells with one another and with the vessels may be well studied in the omentum of the rabbit or of a kitten. . . . Inject the vessels with Prussian blue, fix the omentum with a bichromate solution, remove a small piece and let it partly dry as already described. Submit it to picrocarmine for a few minutes, then, for at least 20 minutes, expose to the osmic acid vapor. Fat is thus made insoluble, and the preparation, after dehydration in alcohol and clearing by some essential oil (bergamot), may be mounted in balsam.

Another good stain for fat is made by macerating alcanet root in 90° alcohol. Fix with bichromate, stain for about half an hour, wash, mount in glycerine. All fat becomes red.

TENDONS.

For this study select the filiform tendons from the tail of a rat where they form a unique bundle representing an exceedingly simple tendon. They may be easily and abundantly procured thus:—cut off the tail close to the body. With the fingers break the end of the tail and pull it in two, thus obtaining a bundle of filiform tendons like a skein of thread; keep for study.

Endothelium.—After a rapid washing, put a few of these little tendons, into a solution of silver nitrate, 1 part to 500; place the vessel in the sun and keep the tendons constantly agitated. When opalescent, wash in water, stain with alum carmine, wash

again, and mount in glycerine. If the exposing to the silver has been short the endothelium alone is impregnated; if for a longer time and to a stronger solution, the subendothelial cells will be marked out.

(To be continued.)

Preparing Vegetable Tissue for the Microscope,—Staining.

By ABRAHAM FLATTERS,

MANCHESTER, ENGLAND.

[From Report of the Manchester Microscopical Society.]

I.—TO STAIN WITH LOGWOOD.

After the sections have been bleached and washed:—1. Place them in 70 per cent alcohol for 15 minutes. 2. Pour off the alcohol and cover the sections with the stain, and allow them to stand from 5 to 30 minutes. 3. Pour off the stain and rinse the sections with 92 per cent alcohol. 4. Pour off the alcohol and pass the sections through oil of cloves, and mount in balsam or dammar.

II.—TO STAIN WITH PICO-CARMINE.

After the sections have been bleached and washed:—1. Place them in 92 per cent alcohol for 45 minutes. 2. Pour off the alcohol, and cover them with the stain, and allow them to stand from 45 to 60 minutes. 3. Pour off the stain and rinse the sections with alcohol for two or three minutes. 4. Pour off the alcohol, and cover the sections with an alcoholic solution of picrate of ammonia, and allow them to stand for one hour. This should be renewed and again allowed to stand for 45 minutes. 5. Pour off the solution and rinse the sections quickly with 92 per cent alcohol. 6. Pour off the alcohol, and cover the sections with oil of cloves, and when clear mount in balsam. Rectified spirits and absolute alcohol are sometimes recommended in staining with picro-carmin, but 92 per cent methylated alcohol answers very well for this purpose.

III.—TO STAIN WITH BORAX-CARMINE AND IODINE GREEN.

After the sections have been bleached and washed:—1. Place them in 70 per cent alcohol for 15 minutes. 2. Pour off the alcohol, and cover the sections with the stain, and allow them to stand for 45 minutes. 3. Pour off the stain, and rinse the sections with the acid-alcohol, *i.e.*, one drop of hydrochloric acid to $\frac{1}{2}$ oz. alcohol. 4. Pour off the acid-alcohol, and rinse the sec-

tions in alcohol two or three times. 5. Pour off the alcohol, and cover the sections with an alcoholic solution of iodine green, (1 per cent) and allow to stand for 45 minutes. 6. Pour off the iodine green, and again rinse the sections in about two changes of alcohol, or until the carmine is clear. 7. Pour off the alcohol, and cover the sections with oil of cloves, and when clear mount in balsam. Borax-carmine is by far the best stain for all botanical purposes with very few exceptions. The only other stain required, is that of logwood. With these two stains and a judicious use of hydrochloric-acid, nearly every phase of permanent staining can be effected.

TO DECOLOR AND CLARIFY.

It is sometimes necessary to decolor tissue for the purpose of showing structure that could not otherwise be seen, viz., fructification of ferns, mosses, capsules, etc. To do this manipulate as follows:—

1. Place the specimen as soon as possible after collecting into 92 per cent alcohol, and allow it to stand until the chlorophyll, etc., is all extracted.
2. Pour off the alcohol, and place the specimen in water to relax for about 30 minutes.
3. Pour off the water, and place in potash solution, and allow to remain until clear.
4. Pour off the potash solution, and cover with water, allow it to stand for about 30 minutes, changing the water two or three times.
5. Pour off the water, and cover the specimen with equal parts of alcohol and pure glycerine. Allow it to stand for the alcohol to evaporate. By so doing the glycerine will become concentrated and the tissue permeated ready for mounting in either pure glycerine or glycerine-jelly.
6. If it be desired to mount the object in balsam, pour off the water as in 5, and cover the specimen with 92 per cent alcohol, and allow to stand until dehydrated.
7. Pour off the alcohol, and cover the specimen with oil of cloves, and when clear mount in balsam.

FORMULÆ.

NO. 1. HÆMATOXYLIN (KLEINENBERG).

(a). Make a saturated solution of crystallized calcium chloride in 70 per cent alcohol, and saturate with alum.

(b). Make a saturated solution of alum in 70 per cent alcohol, and add one part of (a) to eight parts of (b).

(c) To a mixture of (a) and (b) add a few drops of a saturated solution of hæmatoxylin in absolute alcohol.

NO. 2. PICO-CARMINE.

Dissolve 1 gm., of carmine in 24 c. c., of liquid ammonia, .88, and add 240 c.c., of distilled water. Dissolve 4 gms. of picric acid in 240 c.c., of 92 per cent alcohol, and mix the two solutions.

NO. 3. BORAX-CARMINE.

Dissolve by means of heat 2.5 per cent of carmine in a 4 per cent aqueous solution of borax and add an equal portion of 70 per cent alcohol.

NO. 4. GLYCERINE-JELLY.

Soak 2 oz., of cut gelatine in 13 oz., of camphor water, dissolve by means of heat, clarify with white of egg, filter and add glycerine 16 oz., carbolic acid $\frac{1}{4}$ oz.

N. B.—For algæ increase the proportion of glycerine.

A Simple Home-Made Polariscopes.

BY I. PERCY BLACKMAN,

SANDY HOOK, CONN.

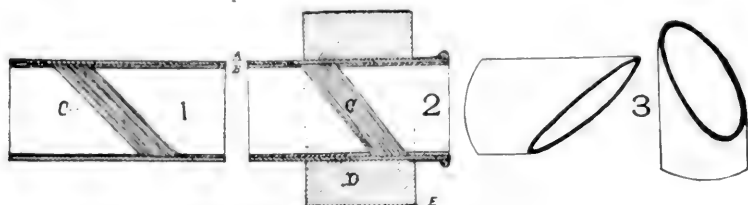
Make a paper tube to fit the draw tube of your microscope. This can be done by gumming writing paper and winding it around a cylindrical stick of the proper size. To this paper tube is to be fitted a second tube that will slip inside of the tube. The outside tube should be about $1\frac{3}{4}$ inches long and the internal tube about $\frac{1}{4}$ inch shorter. Cut this internal tube diagonally through the centre at an angle of about 35 degrees, as shown in Figure 3. Procure from a dealer in supplies for microscopists, about three dozen elliptical cover glasses. Insert one piece of the inner tube, and sixteen of these cover glasses, and then put in the other half of the tube, will hold the glasses in place between the ends of the diagonally cut tube. This forms the analyzer, and is now ready for use.

The cover glasses should be thoroughly cleaned before using, and the paper tubes should be made dead black, inside and outside.

The part that goes below the stage is the polarizer, and is made in precisely the same way except the attachment to support it in position for use under the stage. This, each one can

devise to suit his instrument. If you have a "stage ring" to your microscope, an attachment can easily be made, by having a wooden spool or ring turned to slip into the stage ring easily, with a hole in the centre of the wooden ring large enough to hold the polarizer. Around the outside of this wooden ring, glue a piece of silk to prevent it from falling out of the stage ring, but it must be capable of being turned. The illustrations represent one that I have made, which works nicely and it cost me only about 75 cents.

For the outside tube of my polarizer, I utilized a No. 12 gauge paper shot shell, using the bottom part by cutting a hole through the brass end. This leaves a rim on the end to take hold of to turn the polarizer.



EXPLANATION OF THE FIGURES.

Fig. 1. The analyzer complete ; it goes into the draw tube of the microscope.

Fig. 2. The polarizer.

Fig. 3. The diagonally cut paper tube. A, is the outer tube. B is the inner tube. C, the cover glasses. D, the wooden ring. E, the velvet or silk lining.

The polariscope above described, although not as desirable as one provided with a pair of Nicol prisms, is nevertheless worth having and will give its possessor a great deal of satisfaction.

California College of Pharmacy.—The Department of Microscopy in the California College of Pharmacy at San Francisco is in charge of Prof. J. J. B. Argenti. The important vegetable drugs are studied with the microscope. All students are instructed in mounting and preparing specimens and making and mounting of sections as well as in drawing with the camera lucida. The vegetable cell, its structure and contents structure of roots, leaves, stems, seeds, etc., are all shown and explained. Photo-micrography is also taught.

To Mount Certain Salts.

By NO SIG.

PARIS.

1.—SULPHATE OF COPPER AND MAGNESIA.

Mr. Thomas Davies in his work "On Mounting Microscopic Objects" presents with much detail the means of obtaining preparations of the double salt of sulphate of copper and magnesia, which, if carefully carried out, will give very good slides of this handsome preparation.

Before commencing to make the slide it is necessary to be assured of the perfect cleanliness of the glass; the best we are supplied with here is fluted plate, which arrives from England in half gross packets cut exactly to size 1 inch by 3 and well ground at the edges; these slides are generally quite clean and require no further care; on breathing on each one you can at once see if it is clean enough. Those plates that you do not find quite clean should be put at one side and be soaked in a dish containing a small quantity of washing soda, when, in a day or two of time they can be well rinsed in clear water, carefully wiped, and then placed in a packet and be wrapped up in tissue paper.

As it is very essential to have clean cloths, they should be washed in a weak solution of soda (no soap used) and well rinsed in clean water, and rough dried, using a hot iron to flatten them, and kept wrapped up in soft paper to keep them free from dust and grease.

To prepare the solution, mix three parts of a saturated solution of sulphate of copper in distilled water with one part of a saturated solution of sulphate of magnesia, to which add one-tenth part of distilled water and filter.

Have your hot-plate heated by a spirit lamp ready beforehand, take care that it is pretty level, then select a clean glass slide and place it on the card-board guide marked for the center and drop a little of the solution as nearly in the middle as possible keeping the drop smaller than the cover you intend to use in mounting, then place it on the hot-plate until it is evaporated and keep it there for about ten minutes after it is dry when it looks like a gelatine film with thickened border. Have the microscope ready with the polarizing apparatus and selenite plate; when the slide is cool enough to handle, place it on

the stage. It will appear quite structureless at first. In two or three minutes the thickened border will look crinkled and in a few minutes small specks of color will commence, each centre gradually spreading with flower-like crystals, until they meet one another, when they should be quickly mounted in pure Canada balsam.

As it is advisable to mount them as soon as possible after you have arrived at the state you wish to preserve, the glass cover should be cleaned in readiness, while the slide is being heated on the hot-plate.

The simplest and most effectual way of cleaning the covers is by making two round cork pads, which should be quite flat and about 1½ across at the back; with a short handle, like a stumpy rubber stamp; the face should be covered with clean chamois leather, pulled tight and tied around the pad with thread. Take a clean cover out of the box with a small pair of tweezers, place it on one of the pads, and rub it well with the other pad turning it over once or twice, when it will become clean. You can leave it between the pads till you are ready to use it which will keep it free from dust.

To mount the preparation in pure Canada balsam; the cleanest and safest way of using it is to have it in a collapsible tube, the tube should be placed on the hot-plate to liquefy the balsam but not be made too hot so as to raise air bubbles. Warm the slide on the hot plate and drop as much Canada balsam on the slide as will fill the circle of the glass cover when pressed down. Should there be any air bubbles, warm the point of a needle and touch them when they will disappear. If the needle point is red hot the large bubbles will break but there will be a quantity of small ones formed very difficult to get rid of. Take the slide off the hot plate and place it on the card-board guide being careful to place the preparation with the thick edge away from you, so that when you put the cover glass down on the balsam, should there be any air bubbles they will readily escape at the thin edge, while they would be imprisoned if the slide were turned the other way. Then take the cover glass out of the pads with tweezers and put it slanting to touch the balsam from the outside edge, letting it drop onto the slide and press it down to spread the balsam so as to fill the circle and guide it as nearly central as you can. Then put a small brass clip to hold it se

curely ; however carefully done, there is almost sure to be some excess of balsam pressed out at the edges. It is better to remove this at once while the balsam is soft, with the point of a pen-knife, having a small quantity of wood spirit (methyle alcohol) by your side in a porcelain capsule to dip in the point of the knife to keep it from getting sticky; put the slide on one side for a day or two to harden, when if necessary the edges can be further trimmed with the point of the pen-knife dipped in wood spirit.

The slide can then be cleaned with a bit of clean rag dipped in wood spirit and after two or three wipings all round, it will be clean enough to ring with black asphalt. Wood spirit seems to be by far the best solvent of Canada balsam, not smearing so much as spirits of wine or turpentine. The slides can be left without ringing if preferred by warming them on the hot-plate after cleaning. The edge of the balsam will become bright and glassy, but as in time the balsam hardens and is likely to spring off, it is better to take the trouble of putting a black ring round. Centre the circle carefully on the turn-table. By holding the point of a knife near the edge of the glass cover and turning the table slowly round you can see at once which way it is out of the centre, then adjust and so on till it is right. A nice round sable brush mounted in metal, not too large, should be selected ; dip it in the black varnish ; whirl the table round and apply the brush in a sloping position so as to cover the edge of the circle and touch the slide, the table being turned in direction so as not to meet the brush. Do not take up much varnish on the brush, nor turn the table too quickly, for streaks of varnish will be likely to cross the cover from one side to another; nor should the brush be pressed too much. A capsule containing a little benzole should be kept ready at the side to dip the brush in when it gets clogged and should the black ring look thickened in places and uneven in height, dip the cleaned brush in benzole and run it on the turn table over the ring, when it will become smooth and bright.

Put the finished slides away in a box for a day or two to harden, when the slides can be cleaned and labelled. It is always desirable to record on the label the date and the medium in which the preparation is mounted.

(To be continued).

EDITORIAL.

Carborundum.—This new compound is made from carbon, sand and salt, but it is composed of silicon 69 per cent, carbon 30, impurities 1 per cent. Under the microscope it exhibits crystals of a blue color, but with some of a yellow-green color, some black, and some white. The crystals are sifted through a sieve having 2,500 or more meshes to the square inch but are too large to pass through one having 40,000 meshes to the square inch. The three important characteristics of carborundum are great hardness, infusibility and incombustibility. It will therefore be used much as an abrasive material and to some extent replace emery. It can be used to cut diamonds.

These crystals are rhombohedral, both direct and inverse. Professor B. W. Frazier of Lehigh, who has examined some crystals, says: "A flat crystal examined under the microscope in converging polarized light gave the interference figure of a uniaxial mineral, thus confirming the determination of hexagonal symmetry made by measurements with the goniometer."

The Secretary of the Carborundum Company, Mr. C. M. Hagen, has kindly favored us with some specimens of crude material. To a limited number of subscribers we can mail enough to make a few mounts, and to all our contributors who so desire we shall take great pleasure in sending samples.

A New Illustrated Dictionary of Medicine, Biology, and Collateral Sciences.—Dr. George M. Gould has now about ready an unabridged, exhaustive work of the same class, in which he has already earned a reputation, and upon which he and a corps of able assistants have been uninterruptedly engaged for several years.

The feature that will attract immediate attention is the large number of fine illustrations that have been included, many of which as, for instance, the series of over fifty of the bacteria—have been drawn and engraved especially for the work. Every scientific-minded physician will also be glad to have defined several thousand commonly used terms in biology, chemistry, etc.

The chief point, however, upon which the editor relies for the success of his book is the unique epitomization of old and new

knowledge. It contains a far larger number of words than any other one-volume medical lexicon.

Notwithstanding the large outlay necessary to its production on such an elaborate plan, the price will be no higher than usual.

LETTERS TO THE EDITOR.

NOTE.—*This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.*

The Microscopical Preparations of M. Bourgogne.—A box of slides recently received from this eminent Paris artist merits more than a passing word of commendation. The slides possess the merit of cleanliness, (something not always found in the work of alleged professional preparers in this country), and the cell finish is neat, smooth and plain. But this latter feature is a secondary matter, of course, and that which is under the cover glass is the ultimate test. I can only say that the work of M. Bourgogne is as near perfection as is reasonable to expect in human handiwork. I will take space only to speak of two preparations, where all are good. One is a section through the head of the blow fly, *Musca vomitoria*, taken at such a point as not only to show a section of the brain but through the optic nerves to each eye and including sections of the eyes themselves. The other preparation is arranged under a large oval cover glass, and consists of three translucent leaves of the Evergreen Box; *Buxus sempervirens*. One leaf is prepared to show the veining, the other two different layers of structure. In addition, on either side of one of the leaves is arranged artistically three transverse sections of another leaf of the same plant.

The slides are not only objects of art for the cabinet but are a continual incentive to be satisfied with nothing short of the best work in one's own individual attempts at mounting.—A. L. Woodward.

MICROSCOPICAL APPARATUS.

Cedar-Wood Oil.—This oil possesses a growing importance in connection with its use with optical instruments. For this

purpose it is essential that its refractive index should coincide as nearly as possible with that of the lenses with which it comes in contact, and it is usually necessary to condense the oil to some extent. Schimmel's ordinary cedar-wood oil is stated to have a refractive index N.D. 1.50567 at 17° which becomes N.D. 1.51682 when the oil is condensed.—*Pharmaceutical Journal*.

Muller's fluid.—Equal parts bichromate of potassium and of sulphate of sodium dissolved in water, say 2 grammes of each salt to 1,000 cc. water, make the best preservative for specimens. It should be changed daily at first and biweekly after.

MICROSCOPICAL MANIPULATION.

Cleaning Microscopic Slide and Cover Glasses.—Instead of warming the slides one by one over a flame, pushing off the covers, then scraping away the balsam and cleaning with alcohol, put all your slides together in a saucepan with a lump of washing soda and boil them. The heat of boiling is enough to soften most cements and all ordinary resins used for mounting, and then take out the slides one by one, push off the cover-glasses, and put them back. The action of the soda is to convert the balsam or other resin into a grumous mass, which is easily wiped off with a little rinsing. Cover-glasses can also be preserved for further use in the same way, if desired. There being nothing on the surface of new covers and slides which will resist the action of hot water and soda, this method is preferable to the use of strong sulphuric acid, alcohol or the other methods given in the text-books. The exact quantity of soda to be used is immaterial; a piece about the size of an egg to half a pint of water will do.

Solution of Bleached Shellac.—Most of the journals which give directions for dissolving bleached shellac say "soften the shellac by soaking in ether until the gum is swollen, pour off the ether, and add alcohol." The person who tries this will find himself at the end with a large proportion of undissolved shellac. If, however, he takes the precaution to allow the softened shellac to stand awhile, after pouring off the ether, until all of the later not taken up by the shellac has evaporated, and then to use absolute alcohol as a solvent, there will be but little undissolved shellac.

Microscopical Test for Beeswax.—Make a solution of the suspected wax in chloroform, and let a drop of it fall on a slip. As soon as a pellicle begins to form let a cover-glass fall on it, but do not press down, at least not heavily. Put in a cool place and let stand. In the course of from twenty to thirty minutes you may examine it, using a one-fifth objective and two inch eye-piece, and if the wax is free from mineral fats, or from fatty acids, you will observe tufts of feathery crystals form in such manner that each group assumes the shape of dumb-bells, or double balls of crystals, radiating from a common center in each ball.

These balls vary from 25 to 50 microns (1-1250 to 1-625 inch) in diameter, according to the rapidity of evaporation of the solvent. The crystals are the same for yellow or white wax, and in pure wax no other shapes are seen. If animal, vegetable, or mineral fats are present, the wax crystals will be seen intermingled with the characteristic crystals of the adulterating fats. The observation can be made without the use of the polariscope, but the latter renders the detection of foreign fat much easier.—*National Druggist*.

BACTERIOLOGY.

Incoagulable Albumen—a new culture medium.—M. E. Marchal has devised an albuminous solution, with which he has successfully cultivated a large number of bacteria, both pathogenic and saprophytic. The solution is prepared as follows:—The white of fresh eggs is diluted in distilled water and filtered. A solution of 1-1,000 of iron sulphate is then added to the albuminous liquid in the following quantities:—

Albuminous solution, 1 to 5 per cent, 1 to 5 cc. per litre.

“ “ 5 “ 10 “ “ 5 “ 10 “ “ “

“ “ 10 “ 15 “ “ 10 “ 15 “ “ “

The iron sulphate has the curious property of preventing the coagulation of the albumen by heat. The liquids can be sterilised at once in an oven at 115°. The medium thus prepared is perfectly limpid, its reaction being slightly alkaline. M. Marchal finds that this solution is very easily and rapidly prepared, and it also advantageously replaces the ordinary bouillons in use.—*Bull. Soc. Belge Micros.*

Koch's method for examination of the microbes to be found in air. The quantity and different forms of the bacteria in any given situation or dwelling house or apartment can be determined. Koch uses shallow glass capsules about $\frac{1}{2}$ inch deep and 2 inches in diameter, in which he places sterilised gelatine. These are placed inside tall glass cylinders, about 6 inches high, the mouths of which are closed with large cotton wadding plugs. The glass capsule is lowered into the cylinder, and again removed from it by means of a piece of soft metal bent at right angles. After the whole has been sterilised, the cotton wadding plug is removed, the gelatine is left exposed for about 10 minutes, the plug is reinserted, and organisms that have settled on it are allowed to develop at the temperature of the room. These soon make their appearance as small white, yellow or pink points according to the nature of the germs that are present in the air. In addition to these, however, a number of fluffy white, green, or black forms make their appearance. The former consist of bacteria, sarcina or yeasts, the latter of penicillia, mucors, and aspergilli.

A simpler method is merely to allow the germs to settle on plates of sterilised gelatine or potatoes, which are left uncovered for a time. This will give a notion of the species to be found in any given place, but not the number.

MEDICAL MICROSCOPY.

A Tuberculosis Congress has been held at Paris, and the members have arrived at the conclusion that all persons dying of "consumption" should be cremated, as the earthworms bring the germs of tuberculosis to the surface, and so distribute the disease. The congress proposed this order of the day, after hearing an account of experiments made at the Botanical Garden of Lyon, by Messrs. Lortet and Despeignes. These two well-known doctors have filled with earth some flower-pots. In each pot they have put earthworms with spittle of tuberculous patients and fragments of lungs taken from their dead bodies. A month after, they have ascertained that the earthworms contained a great number of tuberculous bacilli and that the Guinea pigs inoculated with these died soon with general tuberculosis.—*Rene Samson, Paris, France.*

MICROSCOPICAL NOTES.

Microscopic Anatomy of the Nervous System. —Profession A. Kolliker of Wurzburg is studying this subject and he has collected, in America, specimens of young alligators and tortoises, as well as of several kinds of fishes (*Lepidosteus*, *Amia*, *Spatularia*, *Scaphyrhynchus*). The Golgi and Weigert method of study which he uses forbids the use of alcohol as a preservative, and requires young animals.

MICROSCOPICAL SOCIETIES.

Lincoln Microscope Club, Roscoe Pound, Secretary.

June 27, 1893.—On account of hot weather and absence of members from the city, it was resolved to hold no more meetings till September. Dr. Philbrick showed the *anthrax bacillus* in tissues. Prof. Bessey showed slides comparing paper from a wasp's nest with a good quality of writing paper, also coarse paper from the same nest with grocer's wrapping paper. In each case the wasp had rather the best of it. Mr. Woods exhibited slides showing the fertilization of the cell which produces the resting spore in peronospora.

QUECKETT CLUB, LONDON, ENGLAND.

Friday, June 16.—313th ordinary meeting; Mr. E. M. Nelson, F. R. M. S., president, in the chair. Mr. Karop said he had found a somewhat uncommon diatom, *Stauroneis legumen*, Ehr. in a gathering made by Mr. C. H. Gill from the River Lea, and he was under the impression that it had not previously been recorded from this locality.

Mr. T. F. Smith exhibited a 1-12 hom. immersion of 1.3 N. A. made by Swift and Son, which, in his opinion was but very slightly inferior to the Zeiss apochromatics of the same focus. Photographs of *P. angulatum* taken with these respective lenses were shown, and the president remarked that although the picture given by the apochromatic was slightly sharper, the difference was very small, and the new objective was undoubtedly of excellent quality.

Mr. Rousslet read a paper by Mr. John Hood, of Dundee, on three new Rotifers, viz.; *Floscularia spinata*, *Polyarthra aptera*, and *Brachionus tridens*, of which drawings were shown.

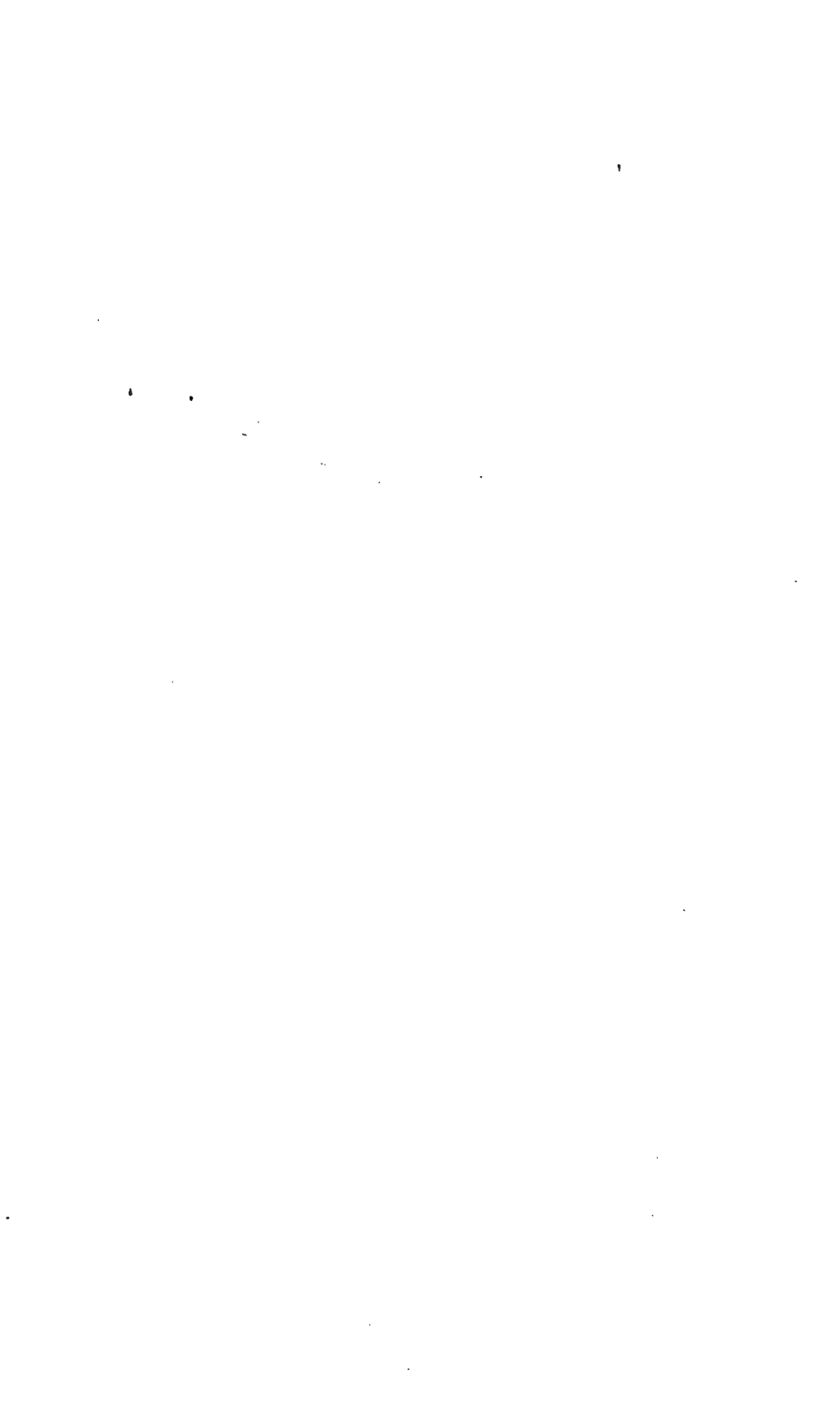
A cordial vote of thanks to Mr. Emery for 14 years service as curator was moved by the president, and carried with applause.

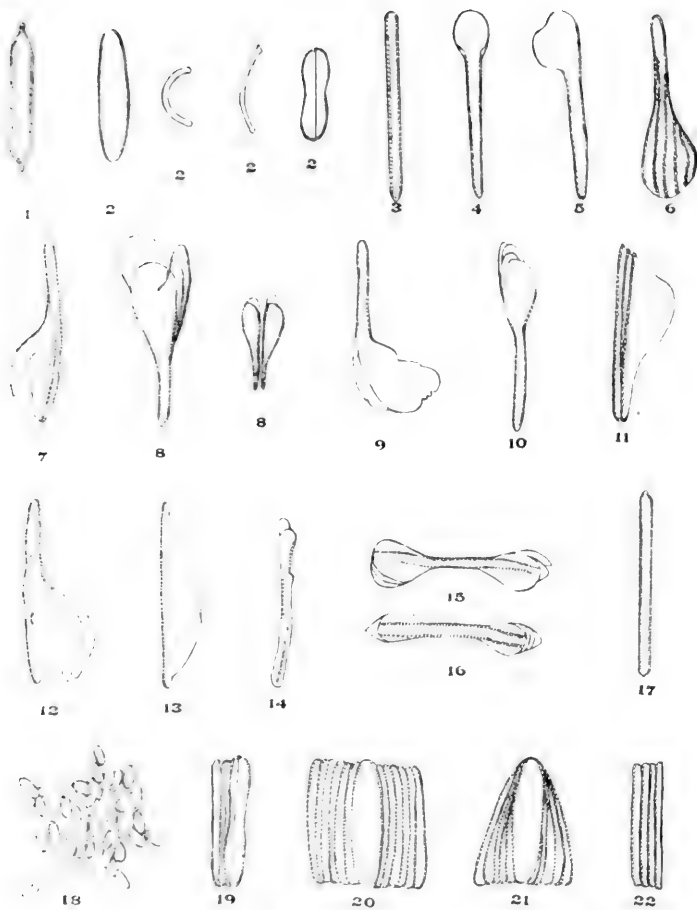
The usual announcements were then made and the proceedings terminated. The next ordinary meeting to be held on Friday, September 15, but the rooms to be open on the first and third Friday evenings in July and August for conversation and exhibition of specimens.

NEW PUBLICATIONS.

Theorie der Optischen Instrumente nach Abbe. Von Dr. Siegfried Czapski. pp. 292. Breslau: Edward Frewendt, 1893.

As would be expected, this volume deals with the mathematics of optical instruments, more especially the construction of lenses both simple and compound. The author has had practical experience in the optical works of Zeiss, in Jena, which has prepared him for the preparation of this most excellent volume on the science of optical instruments. The numerous mathematical formulæ are, in many cases, illustrated by drawings. The work is divided into nine chapters or parts. The first deals with geometrical optics, the second with the geometrical theories of optical pictures including a discussion of the various standpoints for the treatment of the question. Then comes the use of light and its character and effect, a discussion of spherical aberration, acromatism, prisms and prism systems. This is followed with an exhaustive discussion, of the principal kinds of optical instruments. In fact, all of the principles of optics are brought out and demonstrated mathematically. This renders the book of value and it is to be regretted that there is not an English translation although it is presumable that those for whom the book is especially written will find no difficulty in reading the original. The appearance of this volume is a step forward and its effect will undoubtedly be felt in the demand for microscopes and lenses constructed in the best manner. It will teach the people the principles employed in the manufacture of their instruments, which will cause the makers of lenses to put forth their best work. Although the facts stated were for the greater part published, there appears to be no other volume in which all of these important and difficult questions are brought together and explained so satisfactorily as in this one.





DR LOCKWOOD'S ARTIFICIAL DIATOMS

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Aberrant Forms in Cultivated Diatoms.

By DR. SAMUEL LOCKWOOD,

FREEHOLD, N. J.

[From *Le Diatomiste*, June, 1893.]

WITH FRONTISPIECE.

The instructive articles of Dr. Miquel in *Le Diatomiste*, on "The Artificial Cultivation of Diatoms," have recalled certain results of experiments made by myself a few years ago. Some of the forms then obtained were so extravagantly abnormal as to almost challenge belief. Hence it was gratifying to find corroboration in Dr. Miquel's skillful, and careful work. The Doctor writes with charming animation on the erratic forms which he sometimes obtained, and which departures from their proper types, he ascribes to the predominance of certain physical and chemical elements. To these developments he applies the term, "teratological growths."

Unfortunately, I am writing without his article within reach for consultation, hence citation can be only *ad sensum*. The Doctor's efforts provided for his diatoms, so far as possible in an artificial culture, the most favorable and natural conditions of growth. In fact the culture is started and conducted upon wisely intentioned methods. My own work had its origin in an accident, and the two years work thus unconsciously begun, was conducted upon the suggestions which arose during experimentation. The conditions were both unnatural, and unkind. Hence if under the kindly methods of Dr. Miquel occasional "teratological growths" were produced, the wonder is less that in my exceptional laboratory culture occasional forms should

appear in the most *outré* of fantastic, and even monstrous departures from their respective types.

I will state briefly some features of my work alluded to. On the 17th of December, 1886, I read to the New York Microscopical Society, a paper on "Raising Diatoms in the Laboratory," which contained in substance the work of two years. The experiments were conducted at my residence, Freehold, N. J., and in sea-water, although 20 miles from the ocean. Early in the Spring of 1870, with the intention of instituting a marine aquarium at my inland home, I procured from the sea a supply of water in a large wicker-covered vessel. The water was obtained at high-tide, and was so turbid that it had the color of weak coffee; but reliance was placed on its clearing by sedimentation. The vessel was put in a dark cellar, where it was undisturbed, and in truth became almost forgotten, as I was not able to carry out my intention. After fourteen years of darkness, and undisturbed quietude, a little incident brought to mind the sea-water in the cellar. A tuft of the pretty Hydroid, *Sertularia argentea*, having been sent me by a fisherman, into a small glass jar was carefully poured about a half litre of my sea-water. Into this the *Sertularia* was placed, and the whole was set in an eastern window.

I had before supposed the Hydroid was fresh from the sea but badly dried during the transit. There was a faint hope that some of the zooids might be living. All this was in happy ignorance of the fact, learned afterwards, that the specimen had hung for months as a curio in the fisherman's home.

However, vitality was evinced where it was not expected. In about six weeks a discoloration was noticed of the bottom of the jar which was irregularly covered with light brown patches. My surprise was great, when, having put some of this brown matter under the microscope it proved to be composed entirely of diatoms.

I then took from my sea-water in the cellar the same quantity in a similar jar, making sure to avoid every cause of error. This jar containing nothing but the sea-water was set beside the first one. In six weeks similar light brown patches appeared on the floor of the jar. This matter examined with the microscope proved also to consist entirely of diatoms. Some of this growth was collected in a small phial, and sent to Prof. H. L. Smith,

the diatomist. In due time a mounted slide of this matter came from Professor Smith with a note, saying that the diatoms belonged to three genera, *Nitzschia*, *Amphora*, and *Navicula*—the *Nitzschia* being the most and the *Navicula* the least numerous.

A third jar in every respect the same as the second gave similar results. It was thus made evident that the Hydroid had nothing whatever to do with the results obtained.

In another experiment two jars of the same size as the preceding were taken. Into one of these jars a half litre of the sea-water was drawn off at the top with the utmost care so as to avoid roiling the water. The large vessel was then violently shaken, so as to agitate the entire body of water, and at once, while thus roiled, a half litre was put in the other jar; and both jars set in the same eastern window. In two days, the turbid water became perfectly clear, and on the bottom of the jar lay a film of the mineral mud, with a few single valves of diatoms—but not one entire frustule.

In due time, both jars were carefully inspected. The one containing the carefully drawn water gave no sign at the bottom of the jar, and it required many dips taken for the microscope to obtain even one diatom, which was a *Navicula*. In the jar containing the water which had been roiled, on the thin pellicle of mud at the bottom lay a large yield of diatoms. I thus inferred that if undisturbed for a sufficient time the spores lay at the bottom in the large vessel, and that a slight disturbance might cause some to rise in the water. In both jars were a few green uni-celled algae, doubtless from spores received from the air.

Using the same size jars, and in each the half litre of water from the same source of supply, I resolved to vary the experiments. The water was carefully and slowly filtered through several thickness of chemist's filter-paper, the water before filtering having been purposely roiled. The filter started with passing 90 drops a minute, but took 90 minutes to filter a half litre. The filter papers so used were set aside in a little water to prevent drying. In the usual six weeks, or about, this filtered water yielded the same rich crop of diatoms.

Of the remaining experiments it must suffice to mention one. The water in the vessel in the cellar was thoroughly shaken up, and a litre of this roiled water was taken, and slowly filtered as

before, and the papers so used were put aside with the others in a little sea water. The filtered water was then subjected to the boiling point, and this was sustained for twenty minutes. When cold, the water was divided equally in two jars, but in one of them all the saved filter papers were washed. Both jars were set in the window, and at the expiration of six weeks an inspection with the microscope was made. The jars containing the clean water did not yield one diatom—and from the bottom of the jar in which the filters had been washed, it required many dips to be inspected before a *Navicula* could be got and in all the examinations only one *Amphora*. Yet in both jars the green uni-celled algae were found, intruders from the atmosphere. The diatom spores, or germs were so minute as to have passed through the filter paper almost entirely. I queried—were these few spores thus retained by the filters larger than those which had gone through? At any rate the few diatoms these produced, so far as examined were of normal forms.

Thus the conviction was forced upon me, that I was dealing with diatom germs, or spores whose vitality had been sustained in darkness through sixteen years. Hence it was a surprise to me that my friend the late Dr. Wolle in his "*Diatomaceæ of North America*," p. xiii, could from my article make such deductions as are contained in the following:

"As regards the longevity of diatoms, * * * * they have been known to survive even though kept for long periods in the dark."

"Besides reproduction by conjugation there is multiplication by division; and as diatoms do not grow these divisions tend to make the resultant diatoms smaller and smaller, until some become so minute, as in the *Nitzschia*, *Navicula*, and *Amphora*, that while living they can go through the pores of filtering paper."

The above I cannot but regard as a singular errancy of deduction—in a word, as contra-statements of three facts which appeared to me to be warranted by my experiments. It was the vitality not of the frustule, or plant, but of the germ or spore for so long a period, and in an environment so adverse; for prior to cultivation not one living diatom was found by the microscope. And certainly, if from a germ or spore, the fission stage of the diatom must be preceded by a growth stage, embryonic one

might say. And to say that the *Nitzschia*, *Navicula* and *Amphora* can go through the pores of filtering paper, is not a little surprising.

Through sixteen years in quietude and darkness the vitality of these germs slumbered. What wonder then, that when aroused to activity there should be eccentricities in the vital conduct. Rather to me the wonder is that for one aberrant form there would develop more than a thousand individuals true to their respective types. But then so monstrous in form were some of these eccentric growths, as to be utterly defiant of verbal description. A few are truthfully shown in the plate which illustrates this article.

NOTE.—We reproduce with the above the figures which were in Dr. Lockwood's paper published in 1886.—EDITOR.

Society of American Botanists.—The botanists are at present much more active in organizing than the zoologists. They were not satisfied with having a Botanical Club in connection with the American Association for Advancement of Science, but they demanded a separate section for botany. They had previously read their papers in the Biological section. Now they are organizing a National society. The Botanical Club at Madison, Wis., Aug. 23, 1893, appointed a committee of ten which was to select enough other persons to make a nucleus of 25. These 25 are to become the charter members of the National Society. A committee on organization, headed by Prof. Wm. Trelease of St. Louis is preparing a constitution and will report next August when the 25 charter members are expected to gather at the A. A. A. S. It is understood that the membership will be limited to persons who have attained considerable prominence in botany. In the list of charter members, we notice a good many names of subscribers to the microscopical literature of the day. A cryptogamous botanist must of necessity be a microscopist.

Mosquitos.—There is no longer excuse for these pests existing as it has been found that a little kerosene oil poured upon a pond's surface when they are germinating will destroy millions of them. Perhaps a few should be saved for mounting as microscopical specimens. We do not want to actually exterminate them.

A New Method of Preserving and Mounting Specimens.

By A. HALY.

COLOMBO, CEYLON.

On taking charge of this Museum in 1875, I had not the slightest doubt about the success of carbolic acid, and expected to make a good show of all our reptiles and fish, easily and inexpensively. My collection of English fish in London had been kept in a covered zinc pail in a solution of 1 in 400, and there was no doubt about the preservation of the animals themselves. A few experiments on the common fish and lizards of the Cinnamon Gardens showed that solutions of carbolic acid in water do not act in Colombo as preservatives at all, whatever the strength employed. I had first employed alcohol for a short time, and then removed the specimens to a solution of carbolic acid and nitrate of potassium.

The substances known commonly as salts, whether as poisonous as corrosive sublimate, or as harmless as alum, are all alike destructive in this climate to any specimens prepared by them. I tried many different kinds and always failed. The only approach to success was made by first preparing the specimens by arsenic paste, and then mounting in kerosine oil. A row of fish prepared in this way was exhibited, and preserved their form and color beautifully for about six months, until one morning I found them nearly all broken up, and nothing left but a precipitate of muscle and bone at the bottom of the bottles.

There was one branch of the animal kingdom, I had always been very anxious to make a good show of, and that was spiders. I naturally looked to microscopical preparations to solve that question, and tried gum and glycerine. This had been given up because of the great difficulties experienced with the air bubbles which formed so abundantly in it; but that did not matter to me. There was something about this mixture that strongly attracted my attention. Its action was unlike anything I had seen before, and I tried our beautiful little gold and red fish in it, so abundant in the Colombo lake, and which are always my first test for the color-keeping properties of any preservative. I found these little fish became semi-transparent and as hard as glass, and that their colors seemed as though burnt in. Twelve months afterwards those in kerosene had broken

up; but those in glycerine were as perfect as ever. The enormous expense of the process I overcame by filling up the bottles with lead vessels painted white. This saved glycerine; but the gum was also costly. Then the fish were dehydrated in spirit, so that the gum and glycerine could be used over and over again. Only very scaly fish, such as sea perches and wrasses, and a few echinoderms, can be prepared in this way. Ordinary fish, snakes, and frogs are withered up by it out of all recognition, and rendered as hard as iron. Was there any possibility of rendering the specific gravity of the gum and glycerine less? I devoted myself to this for a long time. No additions of watery solutions of any substances were of avail. At last I found that by gently mixing with weak spirit, briskly stirring all the time, that the gum, at first precipitated in flocculent masses, was re-dissolved, and that in that way solutions of almost any specific gravity could be obtained. But it is only very small specimens that can be mounted in this way, the medium being too opaque for any larger bottles, nor is it a good mounting medium even for them.

If we attempt to mount specimens preserved in this way in pure glycerine, they are shrivelled up almost as badly as if preserved with the full strength of the gum and glycerine mixture. Many attempts were made to reduce the specific gravity of the glycerine. Why not try spirit? Glycerine and spirit are most powerful preservatives, and have the inestimable advantage in this hot climate of not evaporating, but they are absolutely destructive to all color, bleaching the specimens with great rapidity. If watery solutions of salts or acids are used to reduce the specific gravity, a grand crop of fungus springs up at once. The only successful chemical was chloral, but it was soon found that light colors faded in watery solutions almost as soon as in alcoholic preparations.

My next experiments were solutions of gelatine in spirit. This is a very good preservative, but it does not keep bright color. There is, perhaps, nothing better for frogs, all the delicate folds and glandular lines so important in identifying the species of this very difficult class of animals being preserved as in life. The mixture is made by soaking a packet of Nelson's gelatine in a pint of cold water for ten or twenty minutes, which is sufficient in this climate. Dissolving it by a gentle

heat, it is then carefully stirred up with sufficient cold-proof spirit; the mixture should measure about 40 degrees below proof. We have now two processes—one a splendid color preserver of very limited use, the other an excellent preservative for very delicate objects, but not a preserver of any bright color, although for dark tints it does very well.

(*To be concluded in November.*)

ON MICROSCOPICAL DRAWING AND PAINTING.—I.

By ARTHUR C. COLE,
LONDON, ENGLAND.

[From *Methods of Microscopical Research.*]

A great teacher has said "Drawing should be considered not an accomplishment, but a necessity. Learning to draw is learning the grammar of a language. Anybody can learn the grammar, but whether you have *any thing to say* is another matter."

There is no royal road but that traversed by enthusiasm and earnestness. Sketches from the hands of a dexterous microscopist, marking first impressions, are often more valuable and superior than the formal work of the mere draughtsman, who may not even know the significance of the subject, especially when the result is a replication of drawings made by the actual observer. He necessarily falls into one or other of two errors; he mends and improves, or obscures material points by drifting into formal monotony; a microscopical draughtsman must essentially be a microscopist, and work *direct from actual observation*, completely understanding the matter before him.

There are three well defined characteristics of microscopical representations, drawings of tissues, or minute organisms, requiring for elucidation high powers, delicate conditions of light, conducted under careful observation and technical skill, satisfying the highest biological research, in its progress demanding rigorous precision; then, rapid sketching, catching features, graphic memoranda; without hesitation, or the assistance of the camera-lucida jotting down, and washing in, with tints, unexpected appearances. This readiness should be cultivated by those desirous of adding record to observation; many most important phases in the sequence of activities have been seen and passed over, when a few rough lines would have induced and helped further research, but beyond this tentative work, and

the stern formality of scientific requirement, is a finished "picture." At this crucial point the capability of the microscopist and artist blend, involving knowledge of the subject, the arrangement of optical apparatus, judgment, and study in the methods of procedure. A drawing may be true in its scientific aspect, and possess artistic features of decided interest—the one may incorporate the other.

Although the bias of an expert microscopist and practised artist may not often touch the same mind, it is certain that when a keen perception is directed to complications of beauty, with rare conditions of light, and effulgence of color, the instrument becomes the very touch-stone of artistic feeling, and, beyond mere beauty (which, in visible nature, is inexhaustible) there are revelations of structural form, quaint elegancies, mysterious changes of tissues, and embryological developments, under radiances, hidden, not only from ordinary familiarity, but even from the cognisance of many who have not had the opportunity of exhausting the resources of a fine instrument, with all its accessories.

A microscopical drawing may be absolutely true, and an artistic grace secured, by preserving line for line what is actually presented, assuming the preparation to be fairly perfect, in other words, not drifting into a stilted diagrammatic style, or wandering from close observation, because the subject *appears* to have a certain regularity; no two cells, vessels, or fibres are absolutely alike; to give "life" to a picture, every part of the structure should be a portrait, the pencil deviating from accuracy melts into falsity and confusion, *uniformity is fatal*, and obscures important differentiation of parts; again, in order to delineate what is expected, or wished to be seen, aiming at "correction," is to be avoided; it is better to draw imperfections, if they be present. An overlapping or torn structure often reveals an important fact, so patent is this, that a "fabricated" drawing may be detected in a moment, especially of Diatomaceous or Infusorial forms—a broken fragment, a solitary individual, is the clue to a perfect whole, or group; such built up arrangements have no charm beyond technicality. A good representation possesses a mingled quality of accuracy and imperfection, a paradox, which stamps its value! Suppose a preparation of vertical section of human scalp of rare excellence, double stained,

disclosing beauty in many perfect hairs traceable in their course direct from the base of the bulb, embedded in the follicle, and emerging from the cuticle above. In cutting a section of such delicacy it would be impossible to avoid slicing through a hair or two diagonally, thus leaving the tops of some, the ends of others; this result or defect, is a feature of significant interest from an art point, faithfully copied it gives life and character. In a diagram, the imperfection, by comparison with perfect hairs, might be remedied, the mutilated parts "restored;" but such an interference destroys at once the graphic quality of the picture, adding nothing to its scientific interest. Absolute accuracy in depicting what is presented may, however, in some cases, be qualified, and truth evolved by a knowledge of the structure as it *should* appear, particularly in cellular tissues, in close contact. In such cases the artist ought to be cognisant of elementary forms, as arranged under contiguous pressures, and the position of spherical, oblong, or cubical elastic cells, as affected by juxtaposition in, over, or under spreading layers. Coupled with the perspective of such conditions, this facilitates progress. In opaque subjects, under binocular vision, where the rotundity of a reticulated surface fades in dimensions, and shadow, in different lines, this abstract knowledge is important, and should be acquired, as many objects could not be effectively represented without its study—always keeping to general appearances; it is an ability which removes difficulty in unravelling the disposition of parts, especially under high powers; when sections are cut either too thin, slightly oblique, or disrupted by the knife, the mechanical interferences of parts when understood, may be restored. The functions of an artist, cognisant of a condition of antecedents may be fairly exercised in the progress of a drawing, but it must never trench upon absolute truth and discrimination in treatment—a drawing may be ruined in a moment by a false line involving impossibility of structure; to a critical eye, this is fatal. In fine work, dealing with malpositions, shrinkage of tissues, disseverances and pseudo-appearances—inevitable even in the finest preparations—the utmost judgment is required.

The effect of a microscopical drawing is enhanced by its inclusion in a circle—surrounded by a black margin—forming a square. The size of the circle is important—it may be too

large, or too small; experiment proves that a space three inches and three-quarters in diameter approximates nearest to the impression made on the mind, of a "field" as seen with a B eye-piece, this circle may encompass magnifications under any power. A metal plate four inches and three-quarters square, with an opening of the dimensions given, should be procured, this ascertained gauge will soon prove a necessity—placed on a drawing block, a pencil swept round the circle and outside the square gives the interior for the drawing and the line for backing with India ink—these discs should be prepared before the work is commenced, and the importance of this arrangement will be easily understood.

The Meeting at Madison, Wisconsin.

The Sixteenth session of the American Microscopical Society was arranged to commence two days before the A. A. A. S. meeting at the University of Wisconsin. At both, the attendance was small. About 15 new members were elected and four or five papers got read. Those entered for publication were—

A new clearer for collodion, by Pierre A. Fish.

The simplification of laboratory methods, by Wm. C. Krauss.

The effect of acid urine and solutions of chromic acid on red blood corpuscles, by M. L. Holbrook, M. D.

On sectioning fern prothallia, and other delicate tissues, by Mason B. Thomas.

Parasitism of the Broom rape on beech roots. *Epiphegus* on *Fagus*, by Herman Shrenck.

A contribution to the study of the Myelin degeneration of pulmonary alveolar epithelium, by Veranus A. Moore, M. D.

The study of reagents in micro-work, by V. A. Latham.

Minute structure of certain aerotropic roots, by W. W. Rowlee.

Points in the history of a new *Distoma*, by Henry B. Ward.

The arrangement and structure of the muscles of the Lamprey (*Petromyzon*), by S. H. Gage.

Sarcina ventriculi in medico-legal investigations of blood stains, by W. N. Sherman, M. D.

Progress in investigation of diatom structure. Some new photomicrographs by T. H. Smith of London, by Jacob D. Cox.

A spectroscopic study of colored inks. A metric study of

2000 cheek signatures. A steel bar plated with Iridium for micrometric purposes, by M. D. Ewell.

On the blood of *Cryptobranchus* and *Necturus*. On the structure of the teeth and bones of Paleozoic fishes. The action of leucocytes towards foreign matter, by Edith J. Claypole.

Prof. W. S. Miller, of Wisconsin University, gave a very full description of the methods of reconstruction of the lung from thin serial sections, many hundreds of which are made about two-hundredths of a millimeter or one twelve-thousandth of an inch in thickness, and sheets of wax one-twelfth of an inch thick or 100 times as thick, which are cut out like the sections, only 100 times as large, and are piled on one another till a part of a lung is modeled on a scale 100 times the size of the actual organ. Thus the real construction is made much more familiar to the mind of the student. Other organs may be made in the same way.

The committee on prizes for microscopical investigation appointed last year reported the awards as follows. One prize of \$50 to Miss Edith J. Claypole, of Akron, Ohio, for her examination of the blood of *Necturus* and *Cryptobranchus*; one prize of \$50 to Herman Shrenck, of Brooklyn, N. Y., for his investigation of the parasitical relations of epiphegus, or beech drops, a plant without chlorophyl, growing on the roots of beech trees (both of these essays were theses for a degree from Cornell University and were copiously illustrated by numerous beautiful drawings); one prize of \$20 for six microscopic slides, illustrating the structure of the human spinal marrow, by Wm. C. Krauss of Buffalo, N. Y.

The society voted to publish 500 copies of its proceedings and also to add abstracts of American microscopical work. The committee on universal screw reported progress and was continued. It was decided not to give a soiree this year. The local committee gave an excursion on Lake Mendota.

OFFICERS ELECTED FOR 1893-'94: For President, Dr. Lester Curtis, Chicago, Ill. Vice-Presidents, Prof. W. W. Rowlee, Ithaca, N. Y. and Prof. W. S. Miller, Madison, Wis. Secretary, W. H. Seaman, Washington, D. C. Treasurer, C. C. Mellor, Pittsburgh, Pa. Executive Committee, Dr. Lyman Deck, Salamanca, N. Y., Dr. V. A. Moore, Washington, D. C. and Prof. T. D. Biscoe, Marietta, Ohio.

Observations on Amoeba and Stentor.

By JAMES H. LOGAN,

ALLEGHENY, PA.

Though one of the smallest and simplest of living things the *Amoeba* forms a most interesting object under the microscope. Its soft and semi-fluid body is capable of putting on a thousand different shapes. As it creeps along throwing out fingers or branches, the contents of the interior, including many forms of microscopic organisms on which it feeds are clearly visible. All these may be seen rolling and tumbling into the advancing protrusions of the body.

Within the *Amoeba* appear two round objects. One of these composed of a multitude of very small granules is called the nucleus. The other of about the same size and a pale pinkish hue or colorless, alternately appears and disappears and is known as the contracting or pulsating vesicle. Besides the above, brownish or black shrinking masses which represent partially digested organisms and numerous minute black granules are seen. Among these, freshly swallowed forms of both animal and vegetable organisms, some alive and some dead, attract attention, for the *Amoeba* is omnivorous and nothing toothsome comes amiss to him. A rapacious animated stomach is the most apt comparison we can make of this strange creature. As will be noted further on, its many and often successful efforts to capture more highly organized creatures of its own size, are an intensely diverting spectacle which one delights to watch for hours at a time.

In capturing, the *Amoeba* creeps over, or else envelopes its prey by inarching protrusions from the body which meet and fuse together forming a cavity in which entrapped animalcules may often be seen whirling and twisting in a vain effort to escape. In this fatal chamber many a beautiful form with its fine colors in all their original freshness is often seen expiring, and then shrinking into a dark shapeless mass.

Amoebas obtain their food from the thin layer of animal and vegetable organism on the surface of mud under water, or enveloping the stems and leaves of submerged plants. During the observations here recorded, the writer found them, one day, creeping in great numbers up the sides of a glass jar.

Frequently the animal is found in the quiescent state when it takes on a smooth round or oval form. At such times, short finger-like processes may be seen pushing out from the ball and then being drawn in again. In the active form these processes take on a great variety of shapes resembling clubs, potatoes, or a body with many arms and branches. Figure 1 represents the quiescent form, while the changes of the active state are shown in the succeeding figures. Sometimes multitudes are found joined together in an irregular network or continuous sheet. So far as the writer's observation goes, these are simply individuals in close contact. Neither among these films, nor among individuals was anything like real fusion observed. During the month of March of the present year a gathering from the tanks of the Phipps Conservatory in the Allegheny public parks yielded many films quite free from the mud which usually obscures them. The observations here recorded are the result of an examination of this gathering. Naturally there was a curiosity to see if there was anything like fusion or conjugation among such a multitude, but careful and long continued search did not reveal it. In every case the patches were found to be composed of individuals, each with its own separate nucleus and contractile vesicle. The line of junction between contiguous *Amœbas* was always discernable. Once in a while individuals were seen to detach themselves from the patches and move away in search of food.

During the examination of these patches a remarkable and unexpected thing was noticed. Many *Amœbas* were found united together not in films, but in a linear series of three to six and even ten individuals. Here, also, there was only a close contact and nothing like fusion. It was thought that the individuals would move in different directions and so pull the lines to pieces, but nothing of the kind happened. In a long time of ten *Amœbas*, four near the lower end were observed in motion at the same time, all advancing towards the left and in a direction at right angles to the line. This was indeed a veritable phalanx of *Amœbas*. The fact that several such lines were seen makes one wonder at its significance. That this linear arrangement was purely accidental does not seem altogether probable. Figure 2 shows the appearance of their curious line.

As some think, *Amœba* films may be connected with the pro-

cess of reproduction. Possibly another explanation is, that *Amœba*, like many other microscopic forms, is gregarious in its habits, and unites for the purpose of gathering up the food in its track. In the patches here observed, many individuals were more or less gorged with the other organisms lying or moving around them. It seems plain from some incidents related further on that at least two individuals can and do unite for a common purpose.

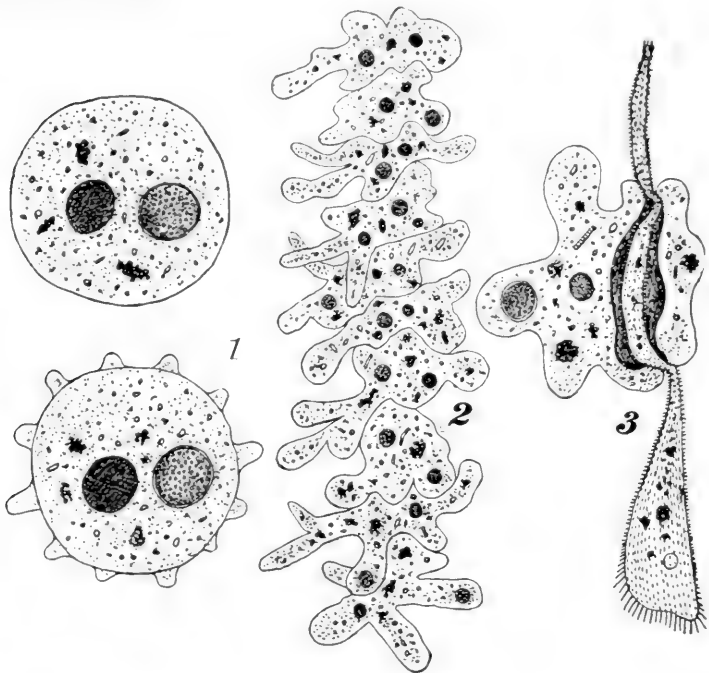


FIG. 1.—QUIESCENT STATE OF AMŒBA. THE LOWER ONE IS PUSHING OUT AND DRAWING IN SHORT FINGER-LIKE PROCESSES.

FIG. 2.—A LINE OF TEN AMŒBAS IN CLOSE CONTACT, FOUR OF THE LOWER ONES ADVANCING TO THE LEFT.

FIG. 3.—A STENTOR WHOSE MIDDLE IS ENCLOSED AND PINCHED BY AN AMŒBA. THE STENTOR DREW ITSELF OUT OF THE CAVITY AND ESCAPED UNINJURED.

Of all things connected with the *Amœba*, those which excite the liveliest interest are the combats frequently witnessed in its endeavor to capture other animalcules for some of which it seems to have a special liking. In illustration of this the following incidents are narrated.

In the gathering from the Phipp Conservatory before mentioned, the host of Amoebas there found were associated with Euglena, Coleps, Closterium, Trachelomonas and several other genera of Infusoria and microphytes. One slide under examination contained nearly fifty Amoebas and several Stentors. The last, *Stentor polymorphus*, while equaling the Amoeba in size and strength is far more active. When viewing the objects on this slide, attention was arrested by the sight of an Amoeba partly enveloping the foot of a Stentor. The attacked animalcule, though in evident alarm, had not sense enough to loosen its foot from the glass slide, but tore off and left a part behind for the Amoeba to make a meal of. So curious a sight naturally excited much interest, and led to a search for more incidents of the same kind of which quite an unexpected number soon turned up.

Presently another Stentor appeared in the field having the middle part of its body enclosed by an Amoeba and rather severely pinched at two points. With more judgment than the first one, this Stentor, though in a worse plight, drew itself out of the deadly cavity and swam away leaving nothing behind to satisfy its hungry captor. This incident is shown in Figure 3.

The cavity formed to enclose its prey has smooth walls which appear somewhat darker than the remaining portions of the Amoeba's body. So peculiar and characteristic is the appearance of this cavity, that one finding it vacant may always be sure some prey has just escaped. When an animalcule is inside and sufficient time allowed, the opposite margins fuse together forming a closed chamber from which there is no escape unless the captive is strong enough to rupture the Amœba. If left empty, the cavity quickly collapses and disappears.

Further search next brought into view the unexpected spectacle of two Amœbas attacking one Stentor. The latter was half enveloped by one Amœba while its foot was partly seized by the other, but an escape was easily effected without injury. Figure 4 represents this.

Ere long a solitary Amœba and Stentor were found engaged in a struggle which continued for some time with varying success, finally ending in the escape of the latter. At one time their Stentor was almost entirely within the cavity, and had time been allowed for fusion of the edges, escape would have been

doubtful. By pushing apart the advancing edges before there was time for this, the Stentor gained its freedom. This is shown in Figure 5.

The next contest that came under observation proved highly interesting and exciting. It was another battle between two Amœbas and a Stentor, very nearly ending in a complete victory for the former. The Stentor appeared uneasy at the active and persistent efforts made to encircle it. Though easy enough to flee from impending danger, the attacked animalcule stupidly

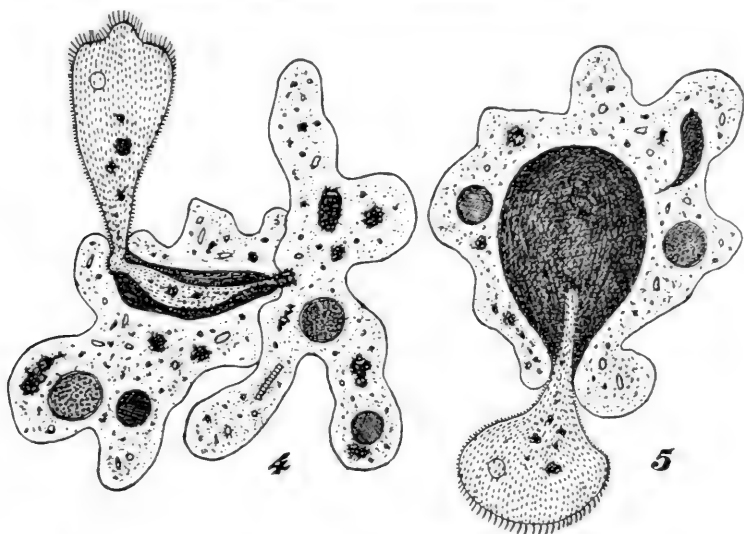


FIG. 4.—A STENTOR ATTACKED BY TWO AMŒBAS. IT ESCAPED UNHURT.

FIG. 5.—A STENTOR ESCAPING FROM THE CAVITY OF AN AMŒBA IN WHICH IT WAS ALMOST COMPLETELY ENCLOSED.

persisted in contracting itself into a globular mass, thus giving all the advantage to its foes. A complete enclosure within the dreaded cavity speedily ensued. The opposite edges were in close contact, but, possibly from lack of time, did not fuse together. It is an interesting question if fusion between two Amœbas really takes place when capturing prey, but the writer has not yet witnessed such fusion. The prisoner was now apparently in a frenzy of terror. It loosed its foot, and continued for some time to twist and roll. Presently it gave a quick jerk as if experiencing a violent shock. After a second shock the Stentor lay still for a few moments as if paralyzed, though the Cilia

continued to vibrate. Reviving in a short time, its violent contortions partly forced aside the walls of the cavity making an opening through which with some difficulty it squeezed out and escaped. The phases of this contest are shown in Figures 6, 7 and 8.

Not long after, another battle was witnessed in the microscopic arena wherein the *Amœba* triumphed. Here two *Amœbas* were joined together and so remained while only one of them attacked and captured the prey. The second *Amœba* kept extending protrusions towards the prey but did not come close enough. In this instance the posterior extremity of the Stentor was bulged out into a round mass which the *Amœba* was ac-

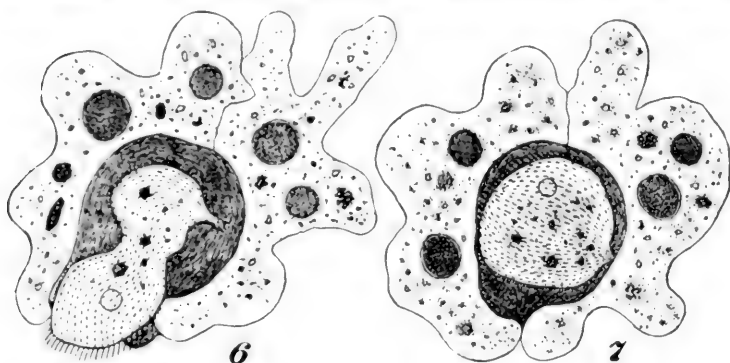


FIG. 6.—TWO AMOEBAS ENCLOSING A STENTOR WHICH, INSTEAD OF TRYING TO SWIM AWAY, CONTRACTS WITHIN THE CAVITY.

FIG. 7.—THE SAME STENTOR AS FIGURE 6 COMPLETELY ENCLOSED IN THE CAVITY BETWEEN THE TWO AMOEBAS.

tively striving to enclose. Like another example, the imperilled animalcule, while making violent contortions, lacked the wit to loosen its foot and flee from the deadly embrace. Instead of this it seemed to choose an evil for a good, for it simply held onto the glass and struggled until it tore off and left behind a large part of itself to gratify the ravenous appetite of its captor. The remaining part sailed away badly mutilated. Figures 9 and 10 illustrate this last combat and its result.

From the foregoing incidents it would seem that *Amœba* has a special preference for Stentor as its prey. Other organisms, upon which *Amœba* feeds were scarcely touched at the time while contact with a Stentor almost invariably led to an eager

and active movement towards its capture. Future observations may bring to light many new and curious facts as to the behavior of *Amoeba* when brought into contact with other forms. Prof. Joseph Leidy, in his fine work on Fresh-water Rhizopods, relates a case where he witnessed an *Amoeba* swallow and digest one of its own kind. He also notes the occurrence of the partly digested bodies of Rotifers within *Amoebas*, but does not speak of having witnessed their capture.

On a former occasion the writer was fortunate enough to see

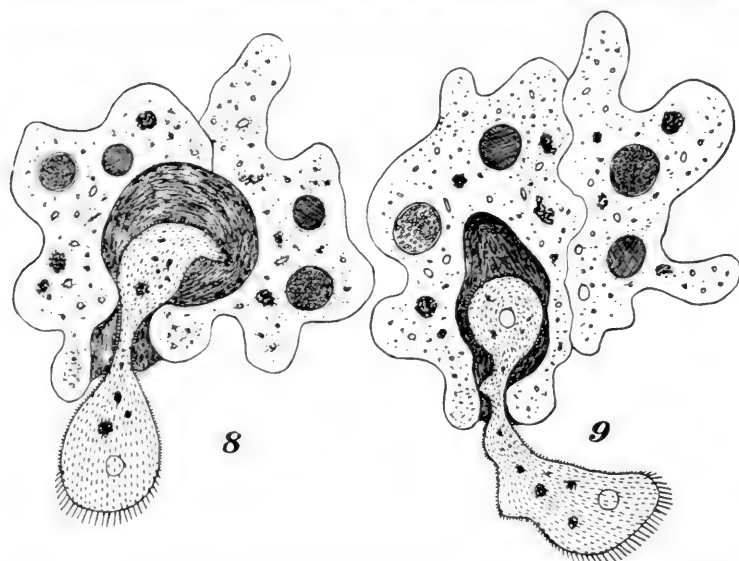


FIG. 8.—THE SAME STENTOR AS IN FIGURES 6 AND 7 FINALLY ESCAPING FROM ITS CAPTORS.

FIG. 9.—ONE OF TWO AMOEBAS ENDEAVORING TO CAPTURE A STENTOR WHOSE HINDER PART IS BULGED INTO A SPHERICAL MASS. THE OTHER AMOEBAS TAKES NO PART IN THE CONTEST.

an *Amoeba* make repeated but fruitless efforts to get a Rotifer within its clutches. The latter is a larger, stronger and more highly organized animal than Stentor. In this case, inching and interlacing arms closed around the Rotifer in an attempt to entangle him. The latter escaped and was again encircled by new arms only to escape them a second time. When last seen, the Rotifer had boldly attached his foot to the body of the *Amoeba*, and kept right on gulping down and crunching the smaller organism which formed his own food. One might eas-

ily fancy that this was done in intentional derision of the Amœba. Figure 11 is a representation of this combat.

It is hard to resist the conclusion that the actors in these tragedies and comedies within a pin-hole, are endowed with some small degree of consciousness and intelligence. Though a frequently observed form, the entire life history of Amœba does

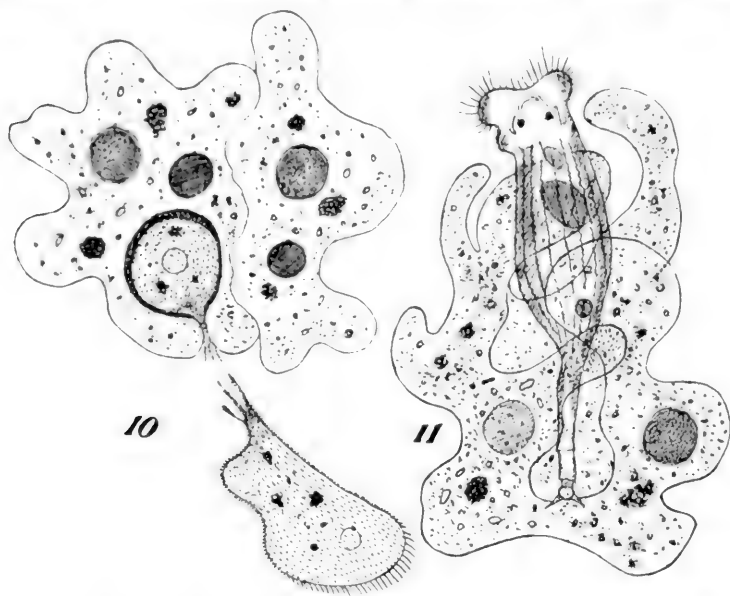


FIG. 10.—THE SAME STENTOR AS IN FIGURE 9 ESCAPING BY SEVERING ITSELF AND LEAVING A LARGE PART BEHIND WHICH WAS AT ONCE COMPLETELY ENCLOSED BY THE AMOEBA.

FIG. 11.—AN AMOEBA ENDEAVORING TO ENCLOSE A ROTIFER BY INARCHING AND INTERLACING ARMS.

not yet seem to be certainly known. Incidents such as those recorded above form chapters relative to the habits of Infusoria, on which subject a good deal yet remains to be written. Figures 1 and 11 are drawn from memory, the others were all made from sketches taken on the spot at the time the incidents occurred.

White's Objects.—Those that I have mounted are beauties and I want 15 more of the cross sections. I think the scheme a fine one. The staining, cutting, and preservation are all to be commended.—W. G. B.

A Preliminary List of the Microscopical Animals
found in the Ridgewood Water-Supply.

By SMITH ELY JELLIFFE, M. D.

BROOKLYN, N. Y.

In the Bulletin of the Torrey Botanical Club for the month of June, 1893, there was published a preliminary list of the microscopical plants found in the Brooklyn water supply; this present list covers the same period of time from November 1st, 1892, to May 1st, 1893, and presents the findings of weekly filtrates taken from the water tap in the writer's house; these filtrates were examined daily and the remainder of the filtrate was preserved for future work.

The number of forms thus far encountered is very small when compared to those found in the Cleveland water supply by Mr. C. M. Vorce; there are, however, a few of interest and the following list includes only such forms about whose identity the writer feels fairly confident.

RHIZOPODS.

- Amoeba proteus*, (Rosel) Leidy. Found during Dec., and Feb.
A. radiosa, Ehr. With the preceeding.
Arcella vulgaris, Ehr. During April.
Euglypha alveolata, Duj. During Feb., and April.

INFUSORIA.

- Pleuromonas jaculans*, Pty. Frequent.
Dinobryon sertularia, Ehr. Common.
Euglena viridis, Ehr. Not common.
E. acus, Ehr. Scarce.
Trachelomonas volvocina, Ehr. During the latter part of April.
T. cylindrica, Ehr. With the preceeding.
T. piscatoris, (Fisher) Stokes. April 9th, what seemed to be this infusorium.

- Mallomonas plosslii*, Pty. Quite frequent.
Paramonas globifera, From. Not infrequent.
Astasia trichophora, (Ehr.) Clap. April 23rd.
Heteromita lens, (Mull.) S. K. Not frequent.
Synura uvella, Ehr. Infrequent.
Peridinium tabulatum, (Ehr.) S. K. Not infrequent.
Gymnodinium fuscum, Ehr. Scarce.
Paramecium bursaria, (Ehr.) Focke. Scarce.

Vorticella microstoma, Ehr. Infrequent.

V. communis, From (?) Scarce.

Litonotus fasciola, (Ehr.) Wrzes. Infrequent.

Chilodon cucullulus, (Mull.) Ehr. Infrequent.

ROTIFERÆ.

Polyarthra platyptera, Ehr. Scarce.

Monostyla lunaris, Ehr. Scarce.

Brachionus urceolaris, Ehr. Infrequent.

Anurea cochlearis, Gosse. Not infrequent.

Seven other forms were seen but their diagnosis is as yet uncertain and hence omitted.

CRUSTACEÆ.

Cyclops quadricornis, (L.) Muller. Not common.

Daphnia pulex, (L.) Muller. (?) Only fragments thus far found.

Bosmina longirostris, Baird. Thus far only fragments of this.

VERMES.

Anguillula fluviatilis, L. Occasional.

The GWA Mixture.—This is an abbreviation for glycerine (1 part,) water (2 parts,) alcohol (3 parts,) and is sometimes called the 1-2-3 mixture. It is used for soaking vegetable sections before mounting them in Farrant's medium.

Triassic Diatomaceæ.—Dr. A. M. Edwards reports (*Am. Nat.*, Sept. 1893), finding diatoms in a clay pit near Passaic, N. J., which he considers to be the first ever found in that geological formation. This Triassic clay contained *Gomphonema acuminatum* and *Brebissonia lanceolata* associated with sponge spicules.

Deane's Medium.—Soak one oz. gelatine in 4 oz. of water until the gelatine becomes soft, add 5 oz. of honey heated to a boiling point, boil the mixture, then cool (but not stiff) add $\frac{1}{2}$ oz. of rectified spirit and 5 drops of creosote. Filter through fine flannel.

Bubbles in Media.—Place the bottle in a pan of hot water until the bubbles rise and disappear.

EDITORIAL.

Deep-Sea Diatomaceæ.—"All departments of Natural Science are afflicted with a host of unwarranted names, and none more so than that of the Diatomaceæ, where at least 20 per cent of the generic and specific names are fictitious." So says Rev. Albert Mann in a report made to the United States National Museum on some dredgings made in the Atlantic Ocean off Delaware Bay by the U. S. Fish Commission Steamer Albatross.

He found in the matter dredged up from a depth of 813 fathoms, 145 species of marine and fresh-water diatoms. He is of opinion that most of these forms were drifted down the Delaware River, though a few probably came in the Gulf Stream from the tropics.

There being already 20 per cent more names than diatoms, Mr. Mann has refrained from making any more new names. Any one who is interested in seeing the list of names of species found by him can consult Proc. Nat. Mus. XVI, 1893, pp. 303-312.

This dredging of diatoms was procured by the Albatross at a cost of many thousand dollars generously appropriated by Congress for the benefit of the Fisheries. These diatoms were or might have been food for fishes. If Mr. Mann instead of spending a large amount of time and labor in identifying these diatoms, had been able to tell us how to multiply indefinitely their numbers he would have contributed an economic fact which eventually might become a factor in improving the fisheries.

Of course, the government did not pay him for doing so, and his study was a voluntary one. If, however, the fishermen are ever to be benefited by the thousands of dollars consumed by the Albatross in dredging the Atlantic for three years, people must be found to do some of these practical things. The French are experimenting along this line and Dr. Samuel Lockwood of Freehold, N. J., is interested in this matter as will be seen from his paper published in this number of the Journal.

But the great question in fish-culture is how to supply a proper kind of food to the fish when just hatched and sent forth to struggle with a hostile environment.

LETTERS TO THE EDITOR.

NOTE.—*This column is open to all correspondents who write upon the topics enumerated under "Problems," or who give other information of interest. The fact that a problem has been answered once need not deter our friends from making additional comments. To facilitate reference, correspondents should cite the number as well as the page on which have appeared letters and queries to which reference is made. The editor is not responsible for the views of others published in this periodical.*

Strasburger's Botany.—In re "Titles of Microscopical Publications" IV, Journal for June, I call attention to "Hand Book of Practical Botany" by E. Strasburger, edited from the German with additions by W. Hillhouse, M. A. F. L. S., 2nd edition revised by author and editor, published in London by Swan Sonnenschein & Co., in N. Y., by Macmillan & Co., 1889.

The above is far superior in every respect to the translation by Hervey which you list, if I am right in thinking they are translations of the same original. I have the first, and the second I saw and examined carefully, but I do not now recollect the exact title. Hillhouse and Hervey however have both translated the same German work and the former is decidedly the better.

GEO. WHITFIELD BROWN, JR.

Proboscis of the Blow-fly.—In reply to an enquiry as to the best method of making the well known preparation of the Proboscis of the Blow-fly (*Musca vomitoria* Linn.) I would not advise any one to make the attempt. Topping had a great success and made a specialty of this slide, which was one of singular beauty, and a valuable test for the performance of low powers, but it is undoubtedly a great feat to reduce to an almost perfect plane, an organ so thick and full of muscle, and having a complicated endo- and exo-skeleton of chitine.

If the attempt is made, the proboscis should be soaked for some time in a solvent, and then most carefully pressed in glycerine.

For the purpose of study, a very good preparation can be made by allowing the parts to take their own position, and if several preparations are made, all the structural peculiarities and beauties will be well exhibited.

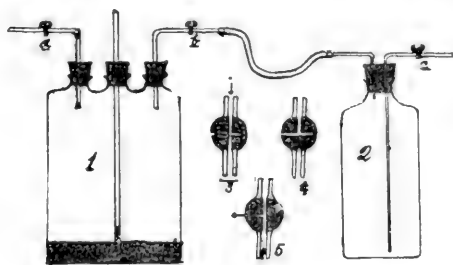
If chloroform is used as a means of death, the proboscis is almost invariably extended.

JOHN MICHELS.

MICROSCOPICAL APPARATUS.

An Injecting Apparatus.—The best arrangement must provide—(1) that the apparatus be simple; (2) that the pressure be capable of measurement; (3) that the pressure be under control such that it may be increased gradually and maintained steadily. Prof. Jas. Middlemass of Edinburgh, Scotland claims to have alone accomplished these results and with the apparatus herein described.

Get a Woulff bottle with three necks (Fig. 1) or a wide-mouthed bottle and india-rubber stopper with three holes. Size, 8 oz. With a syringe introduce compressed air by one of



the necks. By another neck the pressure is transmitted to the bottle (Fig. 2) which contains the injecting fluid. By the second neck, insert a small graduated manometer tube. Then, in the

bottom of this bottle put some mercury—enough to cover the tube to the zero point on the manometer. The mercury may be brought to the same height within the tube by sucking out a little air. This bottle is now ready for use.

In the glass tube which leads into the bottle is a three-way stopcock (*a*). This is to obviate any deficiencies in the syringe (which may be Higginson's syringe, an injection syringe or the syringe of certain forms of aspirator).

Figure 3 shows the position of the stopcock when air is being pumped into the bottle; Figure 4, that when the requisite amount of pressure has been obtained; and Figure 5, that when it is desired to reduce the pressure in the bottle.

It is well, but not necessary, to have stopcocks on the tubes leading away from the bottles (*b*, *c*).

The manometer will measure the pressure in atmospheres, in inches, or in millimeters as desired. Every thing about the apparatus must fit perfectly air-tight.—*Journal of Pathology and Bacteriology*, I, iii.

MICROSCOPICAL MANIPULATION.

A Method of Staining Connective Tissue.—It has been observed, especially by Lubarsch, that in Weigert's method for staining fibrin several other tissue constituents became stained as well as fibrin. Beneke, experimenting with the method, found that connective tissue is often stained by it. He now describes (*Centralblatt f. Allgem. Path.*, July 28th, 1893), a modification of Weigert's fibrin method, by which the connective tissues of the most diverse organs can be consistently stained. Amongst these are, the spider cells and their prolongations with brain substance; the fine fibrous networks between the pia and cortex and around the ventricles are stained by the process.

The fibrous meshwork of sclerosed tissue is shown remarkably well. The principle of Beneke's method lies in the fact that the Weigert stain is not a specific stain for fibrin; it has an affinity, though less marked, for several other of the tissue constituents.

The stain is aniline water gentian violet, the differentiating (decolorising) fluid a mixture of aniline oil and xylol (2 to 1) and of these two ingredients the aniline oil only is directly operative; the xylol merely acts as a controlling agent, having no decolorising power. It appeared probable, therefore, that an increase in the proportion of xylol would further weaken the action of the aniline xylol, and that various tissue elements might be shown which are incapable of demonstration by the original method. Upon this principle Beneke based his method, which is as follows: Portions of tissue fixed in alcohol are cut in paraffin, sections fixed upon the slide, and stained with aniline gentian violet (10 parts aniline oil shaken into fine emulsion with 100 parts water and filtered, add to the filtrate 5 to 10 parts concentrated gentian violet alcoholic solution) for ten to twenty minutes. Treat for one minute with lugol solution of a port wine tint, dry with filter paper, and decolorise with aniline xylol (aniline oil 2 parts, xylol 3 parts). Experience is necessary to decide the moment at which to stop further decolorisation by the action of xylol. Mount in xylol balsam. The connective tissue fibres are stained various shades of violet. *British Medical Journal*, 1893, No. 1705.

BACTERIOLOGY.

Examination of Sputum for Tubercle Bacilli: Biedert's Method.—The object of this is to find the tubercle-bacilli when they are present in the sputum in small numbers. In 1886, Biedert (*Berl. klin. Wochenschrift*, 1886, No. 42, p. 43) called attention to the fact that smearing the crude sputum on the cover glass and staining the same does not give accurate results, so far as detecting the number of bacilli is concerned. This is due to the fact that clumps of sputum that usually contain a larger number of tubercle-bacilli than the more liquid portion are so deeply stained as to obliterate their presence. In order to reduce the sputum to a more homogeneous consistency and at the same time to concentrate into a small mass, the bacilli in a larger quantity of sputum, Biedert mixed the sputum with twice its volume of a 2 per cent solution of caustic potash or soda (soda being preferred) and boiled the mixture until perfectly fluid, after which it was placed in a conical glass and allowed to stand until a sediment had formed. Upon decanting the supernatant liquid, tubercle-bacilli otherwise difficult or impossible to find were readily discovered in stained cover-glass preparations made from the sediment in the bottom of the vessel. In a recent article Biedert again dwells on the value of this method. Although the process requires considerable time, the advantage to be gained by concentrating the tubercle-bacilli in a larger quantity of sputum into a small sediment is obvious. This is also a convenient method for preserving sputum for subsequent examinations, as the bacteria remain unchanged for a considerable time.

Processes based upon Biedert, have been proposed, such as; Kaatzor (*Wood's Monographs*, V, 1890, p. 97.) employed from a 1 to 3 per cent solution of caustic soda or potash, which dissolved the cells, mucus, etc., but preserved the elastic fibers and bacteria. Cover-glass preparations were made from the sediment. He also employed a dilute solution of acetic acid to clear the preparations.

Kiihne (*Centralblatt f. Bakteriologie u. Parasitenkunde*, VIII, 1890, p. 293., added an equal volume of a saturated aqueous solution of borax to the sputum in order to overcome its viscosity and to obtain a thin even layer on the cover-glass. This mixture remained good for several weeks. Putrefaction is pre-

vented and the tubercle bacilli continue to stain nicely. He also used for less viscid sputum a concentrated aqueous solution of ammonium carbonate. Kihne also dwells upon the importance of estimating the number of tubercle-bacilli present.

Muhlhauser (*Deutsche Med. Wochenschrift*, 1891, No. 7, p. 282.) does not advise the use of stronger solutions of caustic potash than 2 per cent. He differs from Biedert in taking a smaller quantity of the sputum and adding from six to eight times its volume of the potash solution.

MICROSCOPICAL SOCIETIES.

Washington, D C., Microscopical Society.

Tuesday Oct., 10, 1893.—The first meeting of the season took place at the Society's room, 714 Thirteenth Street, Dr. V. A. Moore in the chair. Officers for 1893-'94 were elected: President, E. A. Gibbs, M. D.; Vice-President, H. H. Doubleday; Corresponding Secretary, W. W. Alleger, M. D.; Recording Secretary, L. M. Mooers; Treasurer, Dr. Marshall; Curator, W. H. Seaman, M. D. Dr. Lamb proposed that the society offer two prizes for original work, the results to be read before the society at its meetings in February, March and April, 1894. Discussion showed a favorable sentiment and Dr. Lamb, Dr. Reyburn and Mr. Smiley were appointed a committee to develop a definite plan, fix the amount of money to be offered and the terms of the competition. For the purpose of interesting young persons, several members favored holding working sessions and lantern exhibitions. Dr. Alleger, Dr. Balloch and Mr. Doubleday were constituted a committee on this subject.

Dr. V. A. Moore read a paper on Myelin degeneration of the pulmonary alveolar epithelium, a condition which he found accompanying tuberculosis but he has also found it in apparently well persons. Virchoff first called attention to these peculiar bodies which may be seen with 1-5 or 1-10 objective in the sputum of persons affected thereby. Slides and figures were shown.

Out of 53 active members, 14 were present at this meeting which was considered a very satisfactory commencement of the fall campaign. So many of the members are unable to be present habitually that it is proposed to report the sessions quite fully in this periodical the coming year.

NEW PUBLICATIONS.

Analytical Keys to the Fresh Water Algae and the Desmidiæ of the United States. By Dr. Alfred C. Stokes. 8vo. Portland. E. P. Bigelow, 1893. pp. 117. one plate.

The mere announcement of this author's name is enough to commend a book in England or in America. Of all the unselfish and untiring devotees to Microscopy in this country, no one has given so largely of his time and with perhaps so little financial support as Dr. Stokes. He is always doing some good thing without regard to consequences. The better things are, the less money they command, is a paradox in scientific work as in some other fields of labor.

Dr. Stokes laid the foundations for this book in the American Monthly Microscopical Journal. On pages 109-114, 125-131, 144-148, 163-169 of our Journal for 1886 will be found his key to the genera and species of the Desmidiæ. The same matter occupies pages 78-110 of this volume and constitutes Part III of the key. Parts I and II constitute a key to the Algae prepared in precisely the same manner. A spicey introduction, a short glossary and an index complete the volume. These artificial keys are of the same sort as those found in Gray's Botany and serve to initiate the beginner in the identifying of species. Mills' Introduction to the Study of the Diatomaceæ, contains a similar key to the Diatoms. Of course, the sale of the book will be limited to those wishing such a key for identification but we hope that this class will embrace an ever-increasing number of persons.

An Introduction to the Study of the Diatomaceæ. By Fred'k W. Mills. Microscopical Publishing Co., Washington, D. C.

The following review is quoted from the Torrey Bulletin for October and is evidently from the pen of Dr. Smith Ely Jelliffe. As he criticises in some respects rather severely, it might be thought that we should deny space to his criticisms, but believing him eminently fair and just we are willing our readers should have the benefit of his praises and of his censures.

This beautifully printed book is somewhat of a disappointment to the reviewer, and were it not for the extensive bibliography it must be a "twice told tale," and to us not as well

told as it could have been. True it is, that in an "Introduction," an author is not supposed to write a monograph upon the subject, yet we feel that the description of what diatoms are, their habitats and their physiological properties is told in a very cursory manner, and hardly full enough for the beginner to get a real knowledge of the plants. We much prefer other articles upon the subject, both for logical arrangement, completeness and lucidity.

The individual chapters upon Structure, Modes of Reproduction, Collecting and Mounting are too brief, and we cannot but feel that the "Introduction" compares very unfavorably with the "Bibliography," which of itself makes the book of paramount value; such a book that no worker in the diatoms can get along without, and one that will prove of inestimable stimulation to the amateur. We note, however, many gaps in this Bibliography, especially in the numerous papers of later years.

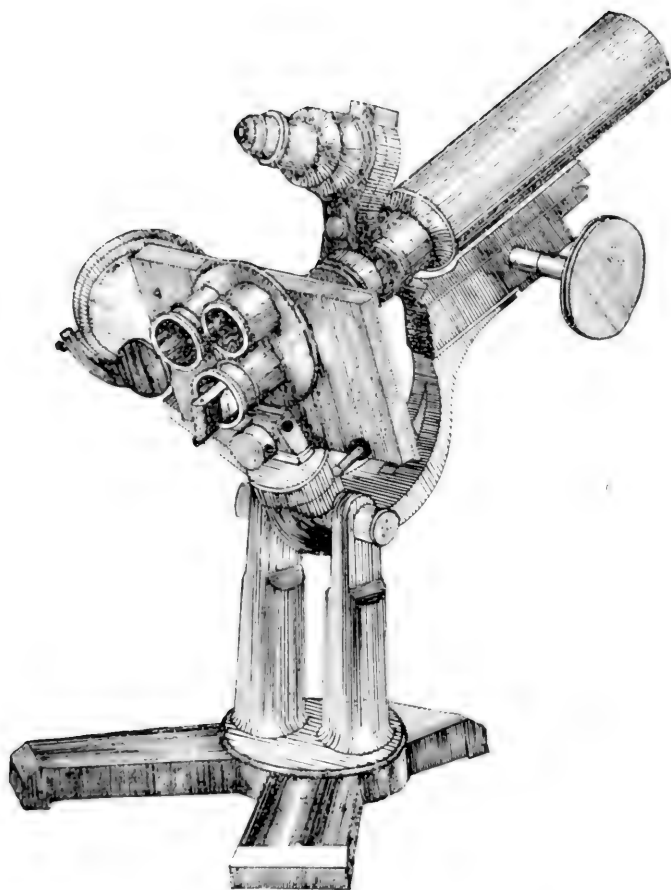
The paper, printing and binding are especially commendable and the book is well worth the price (\$3.50) asked for it.

The Microscope and Microscopical Methods. By Prof. S. H. Gage. Queen & Co., Philadelphia, 1891.

The Journal of the Royal Microscopical Society reviewing Prof. Gage's book, says:

"This is one of the most practical books yet presented to the laboratory student. The aim is to enable him to understand his instrument, in at least its broader principles, and thus to apply it intelligently to the study of histology. It cannot be doubted that there is, chiefly perhaps because of the great variety of subjects requiring to be dealt with in the medical curriculum, a deficiency of knowledge amongst students as to the principles and optical laws involved in the construction and use of the microscope. Prof. Gage evidently feels this, and remembering the little time at the disposal of the student, has sought to condense and put in the most concise and practical form what it is well for him to know about his instrument in theory and practice.

On mounting there are some good practical hints, and there is a very useful bibliography, with an index completing the volume. We conclude that this book has a *raison d'être*, and will, especially in America, command a good audience."



MICROSCOPE SHOWING HANS M WILDER'S SUB-STAGE
ARRANGEMENT FOR RAPID POLARIZATION.

THE AMERICAN

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NO. II.

The American One-Seventy-Fifth Inch Objective.

By E. CUTTER, M.D.

NEW YORK.

[Read at the College of Physicians and Surgeons in Boston, October 31, 1893.]

On July 1st, 1873, Robert B. Tolles delivered this objective to Dr. G. B. Harriman, who had ordered it for the purpose of working up his demonstrations in dental histology. The price paid was \$400.

No mention was made of the one-seventy-fifth at the Tercennial of the microscope lately celebrated at Antwerp. Only a few months ago, the very distinguished Professor J. D. Dana of Yale, whose academic and scientific titles number 25 in the Harvard quinquennial of 1890 and whose gold, silver and bronze medals of American, European and Australian honors, number twelve or more, said when this objective was shown to him that he had not before known that there was a seventy-fifth objective. It is therefore time the one-seventy-fifth was better known. America has produced the highest power objectives for telescopes and microscopes and America should enjoy this credit with no disparagement to others.

DESCRIPTION.

American. Tolles. Wet or dry. Three systems. 170° angular aperture. Working distance 1-250th inch. Magnifies at ten inches from its face, as much as a biconvex lens of 1-75th inch focus, to-wit. 750 diameters—with a two inch ocular 3750 diameters—with a one inch ocular 7500 diameters—with a $\frac{1}{2}$ inch ocular 15,000 diameters.

Screw collar moves 45° . Facial aperture of lens 1-64th inch. The mathematical formulas of this objective cover two pages of

foolscap, which are or were in the hands of Mr. John Green of East Boston. It can be used only on a first class stand. This the writer has practically proved.

ITS UNIQUE POSITION.

Paris.—No word has come from Paris that anything like this objective has been made in France. The French accord this precedence to America, and pronounced the photographs from this objective as not inferior to any ever taken.

London.—In 1889, a representative of Mess. Powell & Lealand looked through the 1-75th, expressed satisfaction in its performance and gave Mr. Tolles the highest compliments. He said he had made a 1-80th, but that it was not practically useful. In 1890, an Englishman in Berlin told me that photographs had been taken with the 1-80th but this does not annul the priority of the 1-75th's work in 1876.

The following incident gives a bit of evidence. In 1889, calling on a high London official of the largest medical society in the world, I asked him if he was interested in microphotography. Said he, with great dignity: "Yes, and I have taken photographs with the highest power ever used, to-wit, the 1-15th inch objective." I asked him if he would like to see some taken with the 1-75th? With some placid surprise he assented and they were shown. All his icy demeanor melted away into the most genial, warm, cordial and even effusive politeness. In the same year the following saw the objective and its work, conceding its position. Sir Morell Mackenzie, Surgeon General Mackinnon, the highest medical official of the British Army; his staff at the war office; the Lord Mayor, 1889-1890; the medical mess at Aldershot; Assistant Professor Lennox of the Royal Institution, the Society of Science, Letters and Art.

Berlin.—In 1890, said the representative of one of the largest German microscope manufacturies, after seeing red blood corpuscles demonstrated by this objective and its stand from Boston: "Doctor, I thank you very much for this splendid exhibition. It is the event of my life. I never saw such instruments before. We don't make them as they will not pay for them."

Vienna.—Here is a letter from Dr. Kohler, written to me on January 29th, 1891, in which he says: "The undersigned, who

at the 10th International Medical Congress at Berlin in 1890, displayed a considerable number of photos, proposes to do the same at a lecture before the Royal Imperial Society of Physicians in Vienna, illustrating the advantages of photography for scientific purposes. In order to be up with the times, the undersigned most respectfully asks if you cannot send him as soon as possible, a few of your best photos?"

Chicago: 1892.—Seeing in the notices of the World's Fair that special agents, sent for the purpose, had secured the most powerful microscope in the world to be brought from Europe, I was anxious to know whether it excelled the American 1-75th. I wrote to Dr. Peabody the Superintendent of the Department of Arts and Sciences that I could not find a practically useful higher power than the 1-75th, but that after this announcement there ought to be and that if Europe was given the first place in the procession when it belonged to America he would stir patriotism in such a way that he would be likely to hear from it. The gentleman kindly replied through others, that there was no objective beyond the 1-75th, and invited me to exhibit it. Things beyond control prevented. There is more evidence, but the above is ample to sustain the claim that America has produced the best highest power objective, which has stood the test for twenty years.

Illumination of this Objective.—Mr. Tolles made a special substage condenser. Privileged to look through this objective at human blood, I thought that the field was darker than it ought to be, from the loss of light by reflection from the mirror, and from the smallness of the condenser lenses. I had practically found that direct light as used more than 200 years ago was more than ample for ordinary work, especially if the thin edge of the oil flame was employed with a Huygen's eyepiece, which wonderfully condenses radiant light to a focus, about a half inch from the face of the eyepiece, the larger lens being toward the light. I asked the privilege to put these ideas into practice. It was given. All substage apparatus was removed, save the diaphragm holder, to which the B eyepiece was fitted with a roll of paste board. The eye glass with cap removed, was toward the stage. The field glass was turned towards the thin edge of the flame.

The tube of the microscope was aimed at the flame which was

placed as close as possible to the stand. By a little adjustment the flame gave a field as bright and clear as an ordinary 1.5 inch field. With a little focusing, red blood was brought out distinctly. With a C eyepiece one white blood corpuscle filled nearly the whole field. After this it was easy to get satisfactory illumination for the 1.75, with a clear and flat field, with good resolution and remarkable definition when the great amplification is considered.

The objective has done good work in three ways. *First*, in ordinary microscopy. *Second*, in Heliomicroscopy. *Third*, in microphotography.

HOW THIS OBJECTIVE CAME TO BE MADE IN BOSTON.

It was made, not as the yacht *Vigilant*, on purpose to beat a foreign one, and uphold national honor, but to help work up the subjects of some 20 papers which Dr. Harriman had written mainly on dentistry. Mr. Tolles had made his first 1-16 inch objective for Dr. H. In 1870, he made his first 1-50 also for Dr. H. Being so well satisfied with these objectives, Dr. H. was desirous to go to the utmost stretch of human abilities in the prosecution of his demonstrations, and the verification of his researches. He approached Mr. Tolles with a proposition to make a 1-75. Carte blanche was given as to time and price. It was a new idea. At first Mr. Tolles would not entertain it. By persistence he was induced to undertake but without giving any positive assurance as to accomplishment. When finished, Mr. Tolles said he would never make another. None other has been made.

ESTIMATE OF THIS OBJECTIVE.

After a use of the 1-75, and a wide demonstration of its work for nearly twenty years, the writer thinks that it has brought out details and features of suitable objects better than lower powers have brought them out. Good judges in this and in other lands have agreed with this estimate, so that it can be said that this instrument of precision is a unique and justly famed masterpiece, that confers honor on American talent and executive abilities.

WHO WAS ROBERT B. TOLLES?

He was born in West Winstead, Conn., in September, 1827; moved to Boston in 1857, where he died in 1883. Early in life,

he was intensely interested in instruments of precision. In 1850, he happened into the workshop of the late Mr. C. A. Spencer, the celebrated microscope maker, and became his pupil. While at Canastota his dearly beloved wife died. To drown the bitterness of his grief, he threw the whole energy of his inventive mind into the difficult work of improving the various parts of the microscope. How industrious he was is seen from the following partial list of his productions :

1. 1855. Invented and patented his solid eyepiece.
2. 1856. Invented his achromatic amplifier.
3. 1858. Achromatic pocket magnifier; flat field; triple lenses.
4. 1862. Cover adjustment by moving the back and middle combinations, the front remaining stationary.
5. 1864. Invented his binocular eyepiece. Both this and one other, were copied by a German maker and sold as his own inventions.
6. 1864. Telescopic magnifier. The principle rediscovered in Europe.
7. 1866. Prism in the side of the objective for illuminating opaque objects.
8. 1867. Made his first immersion lens objective a 1-16th, that resolved Nobert's 19th band, probably the first time it was ever seen. Witnesses; Messrs R. C. Greenleaf and Charles Stodder, late of Boston.
9. 1867-8-9. Wet and dry fronts to the same objectives.
10. 1871-2. Very thin stage with rectangular motions by friction rollers with complete rotation on optical axis—one thing that has not been copied nor imitated.
11. 1872. Semi-cylinder for proving that the angle of objectives may exceed 82° with objects mounted in balsam, by excluding all light of less incidence than half of the maximum angle.
12. 1873. The 1-75th inch objective.
13. 1875. Illuminating apparatus for microscope, swinging concentrically around the object of focal point. Universally adopted.
14. He was the first to claim 180° of angular aperture and prove it.
15. Simplified Camera Lucida.

16. Oblique illuminator.
17. Solid catoptric ocular.
18. Erecting aplanatic system eyepiece for telescope.
19. Short focus, quadruple cemented object glass for telescope.
20. Clinical stage mounted on end of objective as suggested by E. Cutter.
21. Trunnion joint to compensate for wear in stands.

During most of his residence in Boston, Mr. Tolles was a val-tudinarian. He showed many signs of nervous prostration, and after death was found to have diseased lungs and pleura. Though rich in good works that conferred international fame, still he was deprived of the wealth that the richness of his resources of inventive skill should have brought. He received no reward such as his contemporary, Mr. Alvin Clarke, received for making the most powerful telescopic objective of his time; to wit, a Rumford medal. Certainly it seems as if the maker of the most powerful microscopic objective, was worthy of the same reward as the maker of the most powerful telescope.

[NOTE.—After this paper had been read, on a table before all, the B. microscope stand of Tolles was unpacked from its closed box, its parts described, the 1-75 and A. eyepiece were mounted and some red blood corpuscles were focussed. The illumination was from a coal oil lamp with an indestructible and never trimmed clay wick. This wick is the invention of Mr. J. T. Murray of New York, a former partner of Edison. About 25 per cent more illumination is had with this clay wick than with cotton. In turn all the audience then saw through this objective. Being the first and only time that the one-seventy-fifth and the clay wick had been used in a medical college, it is not strange that a Boston teacher of medical microscopy has since said that there was no one-seventy-fifth inch objective]

Bubbles in Media.—Place the bottle in a pan of hot water until the bubbles rise and disappear.

White's Objects.—Those that I have mounted are beauties and I want 15 more of the cross sections. I think the scheme a fine one. The staining, cutting, and preservation are all to be commended.—W. G. B.

Radiolaria Classification Continued.

BY REV. FRED'K B. CARTER,

MONTCLAIR, N. J.

(Continued from page 230.)

Having finished the genera of the legion SPUMELLARIA, or PERIPYLEA, we take up now the genera of the legion NASSELLARIA, or MONOPYLEA, in which the fundamental form of the central capsule is egg-shaped instead of spherical, and the pores instead of being distributed all over it are confined to one area, and the skeleton has the shape of an egg, cone, or bee hive, with one large mouth or opening. This legion is represented by a far larger number of genera in Barbadoes than the former, 120 as against 71. They are capable of being divided and sub-divided, however, in such a way as to render it easier for the student to master them than he would imagine.

Thus, there are two main divisions:

A.—Without complete lattice shell.

B.—With complete lattice shell.

A.—WITHOUT COMPLETE LATTICE SHELL.

IV. *Stephoidea*.—A ring or rings.

17.—Family : STEPHANIDA. One ring.

Branched spines.

Dendrocircus.

No branched spines.

Zygocircus.

18.—Family : SEMANTIDA. Two crossed rings, vertical and horizontal.

A.—BASAL RING WITHOUT FEET.

Two basal pores.

Semantis.

Four basal pores.

Semantrum.

Six basal pores.

Semantidium.

B.—BASAL RING WITH FEET.

Three basal feet.

Cortiniscus.

19.—Family : CORONIDA. Two crossed vertical meridional rings and commonly a horizontal basal ring.

Six large gates. Basal ring with feet.

Podocoronis.

Eight large gates.

Tristephanium.

20.—Family : TYMPANIDA. Two parallel horizontal rings connected by vertical sagittal ring (and often by vertical frontal ring.)

Rings connected by 4 columns.

Microcubus.

Rings connected by 6 columns.

Tympaniscus.

Rings connected by 8 columns.

Tympanidium.

B.—WITH COMPLETE LATTICE SHELL.

This division is huge compared to the former, containing 109 genera as against 11. But they fall conveniently into three sub-orders distinguished by the character of the Cephalis.

V. Spyroidea.—Cephalis bilocular.

VI. Botryoidea.—Cephalis multilocular.

VII. Cyртоidea.—Cephalis simple.

V.—*Cephalis bilocular.*

21.—Family: ZYGOSPYRIDA. *No thorax or second joint.*

A.—TWO BASAL FEET.

Feet simple. Horn on apex.

Dipospyris.

Feet simple. No horn on apex.

Brachiospyris.

Feet branched. Horn on apex.

Dendrospyris.

B.—THREE BASAL FEET.

One horn on apex.

Triplosphyris.

Three horns on apex.

Triceraspyris.

No horn on apex.

Tristyllospyris.

C.—FOUR FEET: TWO SAGITTAL AND TWO LATERAL.

Horn on apex.

Tetraspyris.

D.—FOUR PAIRED LATERAL FEET, ONE APICAL, TWO FRONTAL.

Three horns.

Elaphospyris.

Two lateral or frontal horns on apex.

Tanrosphyris.

No horn on apex.

Therospyris.

E.—FIVE BASAL FEET.

One horn on apex.

Clathrosphyris.

Three horns on apex.

Aegospyrus.

F.—SIX BASAL FEET.

One horn on apex.

Hexaspyris.

Three horns on apex.

Liriospyris.

No horn on apex.

Cantharospyris.

G.—SEVEN TO TWELVE OR MORE BASAL FEET.

One horn on apex.

Petalospyris.

Three horns on apex (one apical, two frontal.)

Anthospyris.

Numerous horns on apex.

Ceratospyrus.

No horn on apex.

Gorgospyris.

H.—NO BASAL FEET.

One horn on apex.

Circospyris.

No horn on apex.

Dictyospyris.

22.—Family: PHARMOSPYRIDA. Cephalis and thorax or second joint. No apical cupola.

A.—THREE BASAL FEET.

One horn on apex.

Acrospyris.

B.—NUMEROUS BASAL FEET.

One horn on apex.

Patagospyris.

No horn on apex.

Desmospyris.

23.—Family: ANDROSPYRIDA. Cephalis and thorax. Cephalis with apical cupola.

Shell spherical.

*Sphaerospyris.*VI.—*Cephalis multilocular and lobate.*

24.—Family: CANNBOTRYIDA. Cephalis only.

No tubes on cephalis.

Botryopera.

25.—Family: LITHOBOTRYIDA. Cephalis and thorax.

A.—MOUTH OF THORAX OPEN.

No tubes on cephalis.

Botryople.

B.—MOUTH OF THORAX CLOSED.

Tubes on cephalis.

Lithobotrys.

No tubes on cephalis.

Botryocella.

26.—Family: RYLOBOTRYIDA. Cephalis, thorax and abdomen.

No tubes on cephalis. Mouth of abdomen closed. *Botryocampe.**(To be continued.)*

A New Method of Preserving and Mounting Specimens.

By A. HALY,

COLOMBO, CEYLON.

(Continued from page 276.)

I now come to a very difficult subject: What is the action of the gum and glycerine? I have long thought, that the gum was the color preserver, and that the glycerine acted first by dehydrating the animal and then by excluding air and water. I was led to this conclusion by the belief that the addition of

water destroyed the colors, by again extracting the gum from the tissues. But I am now convinced this is not the case; the action of the gum is to harden the tissues against the softening influence of the glycerine; the real color preserver is the glycerine, and it preserves because it excludes air and water. It acts as a solid glass, and the only influence at work to bleach the specimen is light, which, curious to say, as the exhibited specimens show, does not seem to have much effect.

Reflecting on this action it occurred to me: if the exclusion of air and moisture is the great ideal to aim at, could not some substance of a lighter specific gravity than glycerine be found? Why not some kind of oil? And of course, in Ceylon cocoanut oil first suggested itself. But cocoanut oil, far from being likely to be a preservative, would require preserving itself. How was this to be done? Would carbolic acid mix with it? I found on experimenting, that carbolic acid mixed with it in all proportions. There was of course, no idea of using this as a preservative, the specimens must be first prepared. Very fluid arsenic paste was used for silvery fish with some success, and reduced gum and glycerine and gelatine was also tried; but from the very first it proved a very refractory mounting medium. It was very difficult to get a sufficiently white oil to begin with and when I did, it always had a strong tendency to discolor. Time has proved that I need not have troubled myself; it cannot be used as a mounting medium. Mixtures of carbolic acid and glycerine, or cocoanut oil, attain a deep color in time, irrespective of any animal matter in them.

There was, however, another difficulty: a very fine cobra, well hardened in spirit after some months, broke down from no apparent cause. It was also found impossible to get a common bloodsucker mounted in this medium. Neither gum and glycerine nor strong spirit, nor arsenic paste, nor anything else would keep them. In fact, the medium appeared either not to be safe or not universally applicable. In order to study it and learn what its action really was, I preserved a bloodsucker in it direct, without previous preparation of any kind, and found that I had a preservative of form as good as any known, and of color as good as gum and glycerine itself. In this case the carbolic acid is either the dehydrator or, perhaps, combines with the tissues and preserves them, whilst the oil acts as the atmos-

pheric excluder; and now you will see why difficult subjects such as cobras and bloodsuckers, previously prepared, broke down. The tissues had absorbed from the alcohol or arsenic paste, or reduced gum and glycerine, a large proportion of water in addition to that naturally contained in them, and consequently more than the carbolic acid could extract or combine with, the result being that they had an atmosphere, so to speak, of their own, which finally led to their more or less speedy decay.

Here is then a splendid medium for the zoologist, especially in a hot climate. He is furnished with a powerful and easily used preservative both for form and color which does not evaporate. The leg of a fly laid on a glass slide in a drop of oil, and just simply covered by an ordinary microscopic glass cover, has remained in the same state for eighteen months. I need not say what a boon this will be to the microscopist, who, whilst wishing to study some subject, does not wish to mount his specimens permanently.

I noticed how exceedingly hard some spiders had become in the oil, when it occurred to me that specimens that had become so firm would resist the dehydrating action of glycerine; and that if spiders would, anything would. The experiment was at once tried on a large rattle snake, seven feet long, some frogs and fish, colored and uncolored with great success.

The oil is also an admirable preservative for large fish skins that can be mounted afterwards. They require no varnishing and retain much of their lustre.

Cocoonut oil is solid at 68° F. In the coldest months in Ceylon it is solid in the early hours of the morning, even on the sea coast, and in the hills it is always solid, as in Europe. When collecting, a gallon or two is melted every morning, which will keep fluid for half a day. The animals are placed in this. When the oil solidifies it forms an excellent packing. When they arrive at the Museum they are allowed to soak in the fluid oil for some weeks. In Europe the oil will have to be kept fluid in a warm room or oven, or some substitute found for it.

The Recipe.—Add carbolic acid to cocoonut oil till the oil marks 10 to 20 degrees below proof on an hydrometer. The more acid the more powerful the dehydrating effect, and judge-

ment must be used. In this climate it is best, although not absolutely necessary, to remove the entrails. Place the specimen, carefully wrapped in rags, in plenty of this preparation. If wanted to mount, drain off the superfluous oil and mount in glycerine.

The Chicago Water-Supply in the World's Fair Grounds.

By SMITH ELY JELLIFFE, M. D.,

BROOKLYN, N. Y.

During a short stay at the Fair grounds, I was enabled through the courtesy of Doctors LeGarde, U. S. A., and E. H. Wilson, to filter some water supplied to the Fair in the building of the U. S. Army Hospital. The material was gathered by filtration through absorbent cotton, the cotton then being washed out in a beaker of water. Though the list is not in any sense as complete as the lists supplied by Messrs B. W. Thomas and H. H. Chace, still it may be of interest to some of the microscopists who have not access to these communications. The filtration was done in the last week of August and material was reserved for future study which material was lost by fire.

VEGETABLE FORMS.

CYANOPHYCEÆ.

Oscillaria, sp. indet. Too fragmentary.

DESMIDEÆ.

Penium, sp. indet.

Staurastrum cuspidatum, Breb.

DIATOMEÆ.

Encyonema ventricosa, Kg.

Navicula radiosa, Kg.

N. rhyncocephala.

Pleurosigma spenceri, W. S.

Synedra ulna, (Nitzsch). Ehr.

S. pulchella, Kg.

S. longissima, W. S. (?).

Fragilaria capucina, Desm.

Asterionella formosa, Hass

Tabellaria flocculosa. (Roth). Kg.

T. fenestrata, Kg.

Melosira granulata, (Ehr). Ralfs.

Surirella elegans, Ehr.

Surirella, Sp.

Cymatopleura solea, S. B. D.

Stephanodiscus minutus, Grun.

S. nigara, Ehr.

PROTOCOCCOIDEAE.

Raphidium polymorphum, Fres.

Dictyosphaerium ehrenbergiana, Naeg.

Scenedesmus candatus, Carda.

S. dimorphus, Kg.

Pediastrum boryanum, (Turp). Men.

P. pertusum. Kg.

ANIMAL FORMS.

INFUSORIA.

Dinobryon sertularia, Ehr.

Euglena viridis, Ehr.

Trachelomonas volvocina, Ehr.

T. (Small, indet.)

Peridinium tabulatum, Ehr. (Dead.)

Litonotus, Sp. indet.

ROTIFEREÆ.

Anurea cochlearis, Gosse.

Philodina, Sp. indet.

CRUSTACEÆ.

Bosmina longirostris, (Mull.) Bd.

Metric Equivalents.—The following should be learned or at least kept ready for reference:

WEIGHTS.

To convert grains into grammes multiply by.....	0.065
To convert grammes into grains multiply by.....	15.5
To convert drachms into grammes multiply by.....	3.9
To convert ounces (avoir.) into grammes multiply by.....	28.4
To convert pounds (avoir.) into grammes multiply by.....	453.6

MEASURES.

To convert cubic centimeters into grains multiply by.....	15.5
To convert cubic centimeters into drachms multiply by.....	0.26
To convert cubic centimeters into ounces (avoir.) multiply by.....	0.036
To convert pints into cubic centimeters multiply by.....	473.
To convert litres into ounces (avoir.) multiply by.....	35.3
To convert gallons into litres multiply by.....	3.8

Karyokinesis in Embryos of the Domestic Cat.

By FRANK S. ABY,

IOWA CITY, IOWA.

In all sections of various embryo kittens that have been examined by the writer, up to those of embryos seventeen millimeters in length, karyokinetic figures are by no means an occasional or a rare occurrence, but are to be found in many situations.

In the preparation of these sections no special technique was employed, as the subject of investigation was the development of the central nervous system of the cat. The embryos were hardened in increasing strengths of alcohol, with no precautions whatever with regard to fixation. After remaining in 95 per cent alcohol for a number of months, the embryos were embedded in celloidin and sectioned. The sections were then stained in Grenacher's hamatoxylin and mounted in balsam.

The resting nuclei are sometimes spheroidal, but the more usual form is that of an elongated oval. Occasionally very peculiar irregular nuclei are found, and one was seen whose length was three times its width, without the aggregation of chromatin to be described later, but with a clearly marked reticulum and nuclear membrane. The nuclear membranes were not shriveled or wrinkled in hardening, but are usually plump and distinct, clear cut on their outer lines, and in almost all cases have taken a deep stain.

The chromatin in these resting nuclei is disposed in a reticulum that strongly reminds one of the bridles seen in the plant cells. This reticulum is clearly continuous with the nuclear membrane, as may be seen in very numerous instances, the point of union of a strand and the nuclear membrane presenting a well-defined enlargement of the strand. In some nuclei which happened to lie in the proper position, several of these points of union in a single nucleus appear in the same plane, giving the nuclear membrane the appearance of being toothed.

Occasionally a nucleus is found in which all that is to be seen within the nuclear membrane is this reticulum, without local aggregations of the chromatin. In the greater number of nuclei the chromatin is so disposed that certain local thickenings may be observed. Under a power of about 500 diameters

these accumulations of chromatin appear to have no connection with the nuclear membrane, but each nucleus seems to have a well defined nucleolus. Under a power of 1200 diameters, however, the connection between the strands of the reticulum and this central body stand out clearly. This aggregation of chromatin may be condensed and in some instances may be described as spheroidal, in other more numerous instances it is elongated, and with its radiating strands of the reticulum, looks very much like a bone lacuna with its canaliculi. Usually but one such body is found in a nucleus, but occasionally there are two side by side, or both near the nuclear membrane, and it is not rare to find four or five. From the behavior of these local aggregations and the strands of the reticulum to hæmatoxylin, it is not possible to determine a difference. Both have about the same tint, and any slight difference of shade may be attributed to the quantity of colorable matter present in the aggregations.

In situations where it is to be supposed that cell multiplication is proceeding rapidly, as in the Wolffian bodies and in the inner lining of the cerebral vesicles and central canal of the developing cord, many nuclei are found whose nuclear membranes are indistinct, in many cases invisible. These nuclei, however are quite conspicuous, owing to the fact that chromatin is no longer disposed in the shadowy strands, but is in heavy solid skeins, taking a much deeper stain than any part of the resting nuclei. Moreover these deeply staining bodies of chromatin in these nuclei assume the position of the nuclear membrane, thus forming a basket with irregular meshes. Thus far I have, not been able to determine whether in these nuclei it is a single skein, or a number of segments, in the formation of this basket; but in certain nuclei where the basket was not very regular, detached segments were certainly determined. In some nuclei in which karyokinesis was well established the loops of chromatin, or chromosomes, were seen scattered through the nucleus, as if the basket had been broken into fragments and crushed in. No traces of the nuclear or achromatic spindle were seen before the monaster stage.

The monaster stage was seen in many nuclei, but the best view was always obtained when the achromatic spindle was lying at right angles to the line of vision. When the aster was seen from the pole the chromosomes were in such a tangle that

no satisfactory view was obtained. In the nuclei of embryo kittens the chromosomes are short and thick, and in the haematoxylin employed took a very deep stain, in many cases almost black. For these reasons it was usually impossible to distinguish individual chromosomes in either the monaster or dyaster stage but the ends of the chromosomes were usually distinct.

The achromatic spindle at this stage is fairly conspicuous and well defined. The chromosomes are seen clustered in the plane of the equatorial plate, while on both sides the fibrils of the achromatic spindle converge to the pole corpuscles. From each pole corpuscle, radiating out into the cytoplasm, are to be seen the exceedingly delicate rays of achromatic substance, forming the polar cones. Many nuclei were seen at this stage presenting the appearance of the conventionalized diagram, such as that in Quain's Anatomy, tenth edition, Vol. I, Part II, figure 214, except that the chromosomes are not so distinct as in the diagram.

In the process of metakinesis all phases were seen, from that in which the limbs remained in contact while the apices of the loops had separated, to the complete dyaster stage. In some instances the ends of the limbs of two or four chromosomes remain in contact, the others having separated. In nuclei in which the two sets of chromosomes have migrated for some distance, and are separated by an interval equal to the average diameter of a resting nucleus, the exquisitely fine webs that stretch from the ends of the limbs of one set to the ends of the limbs of the other set may be seen in many instances. When the two sets are separated by a small interval the web is not easily seen.

In the dyaster stage the two sets of chromosomes do not present the appearance that is usually represented. As stated before the chromosomes of the cat are short and thick, and the limbs do not extend in such a way as to make it easy to determine their number. It is stated that the nuclei of each species contain a definite number of chromosomes. From what can be determined in the nuclei under observation, each set of chromosomes in the dyaster stage contains four chromosomes, although it is difficult to determine this point with certainty.

The portion of the achromatic spindle between the pole corpuscles and the two sets of chromosomes can be made out easily, as the delicate webs are quite conspicuous in the dyaster stage, and

seems to take a deeper stain in many instances than in the monaster stage. The radiating webs beyond the pole corpuscles, extending out into the cytoplasm and forming the polar cones, have not been made out in the dyaster stage.

The chromosomes in the two daughter nuclei then assume the basket form. The baskets formed in the two daughter nuclei are easily distinguished from the basket in the initiatory stage of karyokinesis by the fact that the daughter nuclei occur in pairs, and each basket is much smaller than that formed in the mother nucleus. The meshes in daughter nuclei are also much smaller, and the chromatin is in a close tangle.

The dyaster stage is the most conspicuous of all the stages of karyokinesis in these nuclei, and most easily found. Karyokinetic figures are most abundant in embryos about five millimeters in length; in older embryos they are not so easily found. In examining sections from a five millimeter embryo, some fields showed karyokinetic figures in fully half the nuclei. In these embryos karyokinesis was observed in the following situations:

1. Lining of primitive cerebral vesicles. Here they were most abundant. Nuclei bounding the cavity showed the figures especially well.
2. Lining of the central canal of the cord. Here also very abundant.
3. Lining of the lumina of tubules of Wolffian bodies. Occasional.
4. Epithelium lining the pharynx.
5. Within the bronchial arches.
6. Epithelium lining the bronchial clefts.
7. Optic vesicles.
8. Otic vesicles.
9. Epiblast forming epidermis of face.
10. Walls of heart.

HISTOLOGICAL LABORATORY,
STATE UNIVERSITY OF IOWA,
October, 1893.

To remove odors from the hands.—Flax-seed meal moistened with water will remove the smell of carbolic acid. A paste of ground mustard and water will remove many kinds of odors from the hands.

A Handy Method of Mounting.

By R. B. COUTANT,

TARRYTOWN, N. Y.

In view of the many handy methods of mounting in vogue, any suggestion of new means to that end requires both an explanation and an apology. The devices described herein are those of a busy man who no longer has time to practice the difficult art of ringing slides and of building cells with varnishes and cements. In laying aside the turn-table, the glass slips and the brush, however, he has no wish to decry the products of their use. On the contrary he regrets that he is compelled to employ the crude methods that he recommends, and that he is obliged to content himself with their imperfect results. For these reasons he addresses himself to those amateurs whose passion for the use of the microscope is constantly thwarted by the demands of their every day work, and who, if they did not make use of "handy methods" would have to relinquish their favorite pursuit. By the means to be described a cell can be made, an object placed, a preservative fluid instilled, a cover glass sealed, a slide covered, and a label pasted, in about the time it takes to describe the steps of the procedure. No priority is claimed by the writer in the use of any of the materials named excepting the rubber adhesive plaster, and very likely this has been employed by some one else. The most that belongs to him is the grouping together of the various details given into a working formula.

MATERIALS REQUIRED.

1. A piece of firm, unglazed paste-board, of a thickness dependent upon the depth of the cell to be made.
2. A pair of scissors and a pocket knife.
3. A spool of thin rubber adhesive plaster, one inch wide.
4. A metal punch or cork borer, $\frac{1}{2}$ inch in diameter.
5. Brunswick black.
6. Marine glue.
7. Camel's hair brushes.
8. Thin cover glasses, $\frac{1}{4}$ inch wide.
9. The object to be mounted, properly prepared.
10. The mounting medium.
11. Paper covers for slides. 12. Labels.

METHODS.

1. Cut a slide 3 in. x 1 in. from the paste board.
2. Apply lightly to each side of it a piece of adhesive plaster 3 in. long.
3. Center the slide by drawing diagonal lines from the upper to the lower corners.
4. Place the slide upon a block of hard wood and cut a disc from its exact center by means of the punch or the cork borer.
5. Coat the margins of the opening with Brunswick black.
6. Strip the plaster from one surface of the slide so as to fully uncover the opening.
7. Apply marine glue to the margin of a cover-glass place it over the opening on the uncovered surface of the slide and replace the plaster with firm pressure.
8. Place the object in the cell.
9. Instil the preservative or other medium.
10. Strip the other surface of the slide, apply the second cover-glass after the manner of the first and replace the plaster with care.
11. Apply ornamental back and front to slide, if desired.
12. Label.

If the object to be mounted is an opaque one, apply but one strip of the plaster before the opening is made in the slide.

Then put the other strip in place so as to form a bottom to the cell, which, together with the sides, is to be covered with the Brunswick black. To finish, repeat the details given above.

If the object is so minute as not to require a cell, place it between two cover glasses with a proper amount of Canada balsam, clip and harden, mount in slides of thin paste board or of metal having a central opening just large enough to receive the covers and retain them with strips of the plaster having an opening $\frac{1}{4}$ inch less than that of the slide. The metal slides of tin or sheet iron should be ordered in quantity, ready for use, from a dealer in hardware. If preferred, rings of the plaster, cut by means of circular label punches, may be used instead of strips of the material. Court plaster has been recommended as a mounting medium, but the rubber plaster is superior to it for the reason that it is used dry, that it is impervious to moisture, that it adheres more firmly and does not crack.

The rubber plaster may also be used upon glass slides. Cut

it into rings of proper size by the use of punches, or perforate a strip of it and apply so as to seal the cover and form a front to the slide. Cells can be built of it upon glass by pasting ring upon ring and coating the inner surface with Brunswick black. When finished, attach the cover by means of cement. Objects mounted between cover glasses in brass, tin or rubber cells may be neatly set in paste board slides of corresponding thickness. Punch an opening in the paper just large enough to receive them and secure with a ring or a strip of the rubber plaster.

Perforate the paste board slide and the rubber adhesive plaster separately, upon the smooth end of a hard-wood block, with a sharp steel punch. Save the paper button. Let the strips of plaster be at least $4\frac{1}{2}$ in. long, and make the opening 2 in. from one end of it. Apply the cover-glass over the opening in the plaster upon the sticky side of it. Apply the plaster to the paste board slide so that the cover-glass fits over the opening accurately. Insert the slide, place a suitable amount of balsam in the cell, submerge the object in it with the side to be examined next the cover-glass, and arrange in position with needles. If the object is very thin fit the button cut from the slide with the opening and press into place, wiping away the balsam as it exudes. If the object to be mounted is not thin, split the button so as to obtain a layer of suitable thickness. Apply asphalt or Brunswick black to the edge of the cell and to the side of the button, next the object, if a black finish is desired. Carry the plaster around the end of the slide, paste over the back, trim the ends and finish neatly. Place under pressure until the balsam is hard.

Opaque objects may be neatly mounted in Pierce's cells by using tin or paste board slides without openings, connection being made with plaster, and the surfaces finished with paper fronts and backs. Mention of Pierce's cell brings to mind the fact that an excellent embedding cell for a small Army Medical Museum Microtome may be made by fixing the cap of the cell with marine glue, filing the rim to fit the well of the microtome and dropping it into place in an inverted position. The embedding cell may be deepened by partly unscrewing the plate of the microtome, the groove that is formed thereby serving to hold the embedding material in place.

EDITORIAL.

The San Francisco Society.—We have been much gratified to receive the Transactions of the San Francisco Microscopical Society, Part I, and to note the evidences of increasing prosperity in this society. We are also reminded thereby of the cordial reception and many courtesies extended to the writer, in 1890, when on a visit to the Pacific Coast, by Messrs Breckenfeld, Loy, Reidy, and others.

This brochure of 72 pages contains, as a frontispiece, a photographic view of the society's room. Four papers are published: (1) On Marine Fossil Diatomaceæ from California, by Dr. A. M. Edwards; (2.) The Santa Monica Diatomaceæ, by Henry C. Hyde; (3.) Molluscum Contagiosum, by D. W. Montgomery, M. D., and (4.) The President's Address, by A. H. Breckenfeld.

There is also a brief list of books contained in the library; list of members, list of slides and a copy of the Constitution. The society has 52 members who pay dues at the rate of \$12 per year, thus insuring quite a large income. The initiation fee is \$20.

If we may be allowed a suggestion it would be that these fees stand in the way of students, young people and persons of limited income becoming members and limit membership to men of some means. We dare say that there are many young physicians who ought to be members and to whom that \$20 gold piece (which banker Breckenfeld keeps piled up in such beautiful and enticing piles), is too much a rarity to be always handed up for microscopical purposes.

And yet the maintenance of such a society and the publication of such proceedings means a good many of those yellow beauties which are the foundation of Pacific Coast prosperity.

The San Francisco Society as well as our Eastern Societies ought to devise means for interesting young men and others who have not the means for paying membership fees.

Whether the Transactions are to be on sale or not we have not been informed; and whether this publication will supercede the reports of each meeting which have been furnished us for publication is also uncertain but we may certainly hope not.

Renewal of subscriptions is now in order for 1894.—S. V. P.

MICROSCOPICAL APPARATUS.

The One-Seventy-Fifth Objective.—Dr. Cutter, who is the Professor of Clinical Morphology and Applied Medicine in the College of Physicians and Surgeons at Boston, has sent us some photographs of objects taken with the 1-75th which we hope to publish soon. In order to use this objective, a cover-glass is replaced with a strip of mica only one-two-thousandth of an inch in thickness. Dr. Cutter has practiced medicine 45 years, and has used a microscope nearly all of this time.

The Griffith Microscope.—A substantial recognition for this queen of grace and utility amongst microscopes has been bestowed on its owner, Mr. E. H. Griffith, in one of the most complimentary awards given at the World's Fair. Mr. Griffith's exhibit in the north gallery of the Liberal Arts Building, in the space reserved for the Chicago Academy of Science, has been a center of interest for lay as well as professional visitors at the Fair.

Rapid Polarization.—Mr. Hans M. Wilder of Philadelphia has devised a diaphragm which in the main appears to be a modification of the well-known English "Universal" substage. This, however, was unknown to him at the time. To make it he says:

"Get a diaphragm wheel made with three large holes and one smaller one; the large hole about the size of the largest in the ordinary wheel, and the smaller about the size of the next but smallest. Now solder to each large hole a tube, say, half an inch long, and into each of these tubes fit quite tightly another tube, no tighter than that it can be easily pushed in and out and keep its place, however much or little it is pushed in. Into each tube fit the following lenses:—One of the proper focus as a condenser; one with a black spot on the plane side for dark ground illumination; and a nicol in the third tube, on top of which a plano-convex lens will insure extra bright illumination. For analyzer, use a tourmaline in a fitting which slips easily over the eye-piece. The advantage of the tourmaline is that you get the whole field, and not, as with a nicol over the eye-piece, a field narrowed by the sides of the nicol. That is all. The small hole in the diaphragm wheel serves for observation by ordinary light; if a stronger illumination is wanted,

merely turn the wheel until you get the condenser in place; one turn more, and you have a dark field; one turn more, and the polarizer is in position, and you have then merely to clap on the eye-piece the tourmaline, which latter is to be rotated. It is very easy of management.

A word about tourmalines,—the price, about \$8.00, is outrageous. Get a light-colored tourmaline from any dealer in minerals (Standish, Maine, appears to be the place where such tourmalines are to be found). A piece about half an inch square of varying thickness (at times half an inch thick) will cost about 20 cents, and must be ground down. Cleavage there is none, and it is not brittle. The bluish-colored ones are stated to be the worst, polarizing very little, and the brown ones good, best the nearly white ones, which however appear to be rare."

A nice view of the Microscope fitted up by Mr. Wilder is given in the frontispiece of the present number.

MICROSCOPICAL MANIPULATION.

Sealing-Wax Cement.—Make a saturated solution by exposing an excess of sealing wax in alcohol for several days. Shake the bottle occasionally. This is strictly a varnish and not a cement.

To Cement Ebonite Cells to Glass.—Use a thick solution of shellac in spirits of wine. For glass or metal cells, marine glue is sufficient. The interstices may be filled and the joint rendered air-tight by gold size.

Method of Staining Spores.—The following method is contributed by Philip Jaisohn, M. D., assistant professor of Pathology and demonstrator of Histology in the Medical Department of Columbian University, Washington, D. C.

The Moller's method of staining spores generally gives a fairly good result but a modification, which I have made, produces more brilliant contrast, viz: clean a glass slip in equal parts of sulphuric acid and alcohol; wash it again, in water, (running spigot preferred); wipe off the water with a dry towel; put a large drop of sterilized water on the slip with a pipette and pass through a flame (Bunsen burner or spirit lamp) a few times,

which causes the drop of water to spread evenly on the surface. Take a recent culture and touch it with the end of the ordinary platinum needle and gently pass it through the drop of water a few times, back and forth, without using any force. Keep the slip in a thermostat, at the temperature of from 35° to 38° C. until the water is entirely evaporated. Pass the slide through the flame three times, and place in five per cent solution of chromic acid for two minutes; wash in water, then place for three minutes in the following solution:

Fuchsin,	3½ grams.
Absolute alcohol,	35 c. c.
Phenol,	13 gram.
Distilled water,	230 c. c.

Wash off the superfluous stain in water, and immerse it for half a minute in five per cent solution of sulphuric acid. Wash in water, then place it in saturated aqueous solution of methylene blue (Löffler's solution), for two minutes; wash again in water, dry and mount. The body of the bacteria will stain blue, while the spore will take a brilliant red.

Dissolve the fuchsin in absolute alcohol, and mix phenol in distilled water, then mix the two together, and stir frequently. Let it stand for twenty-four hours, then filter; keep in a tightly corked bottle. Filter again just before using.

A New Method of Staining Spores.—Fiocca (Centralblatt für Bakteria, July 1st, 1893) describes the following method for staining spores, which he states is superior to all others as regards rapidity, simplicity, and certainty. The materials needed are ammonia solution 10 per cent, an alcoholic solution of an aniline dye, a decolorising solution of sulphuric or nitric acid 20 per cent, and an aqueous solution of a constant stain. Place 20 c.cm. of the ammonia in a porcelain capsule, add ten to twenty drops of the solution of aniline dye, warm to steaming, and place the cover slip—prepared as usual—on the stain. If desired, the contrast stain may be dissolved in the acid, as in Gabbett's method for tubercle bacilli. In this case the acid is used in the proportion of 10 per cent. only, and the cover slips remain in it two or three minutes. For staining the spores gentian violet, fuchsin, methylene blue, or safranin are suitable. The contrast stain will vary in different cases. By this method not only spores but the granular protoplasmic structures which

precede the stage of ripe spore, can be stained.—*British Medical Journal* ii, 1893, *Epitome of Current Medical Literature*, p. 25

To Pack Slides for Mailing.—The most economical and a perfectly satisfactory method is illustrated by a package just received from the Microscopist, E. W. Sharp.

Take pieces of wood one inch wide and three inches long (the exact size of a slide). The wood may be from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick. Paste upon each end of one side of these pieces of wood a piece of cloth one inch square. The cloth better be thick. It must be thicker than the cells of the slides which are to be packed.

With these pieces at hand, one hardly need be told how to use them. The first piece of wood is laid down cloth side up. A slide with its cell down is laid upon it. Another slide is laid upon the first back to back. A piece of wood with cloth side down goes next and the package can then be wrapped and mailed just as if it were a solid mass of wood. A piece of blotting paper inserted between the slides will prevent scratching but is not essential.

A New Method of Staining Neuroglia.—Kultschitzky (*Anat. Anzeiger*, April 8th, 1893), has successfully employed rubin ("patent saures Rubin") in staining neuroglia. Portions of brain are fixed in the following mixture: a saturated solution of potassium bichromate and sulphate of copper in 50 per cent. alcohol, to which is added acetic acid in the proportion of 1 per cent. The solution is made in the dark, about twenty-four hours being required. The time employed in fixation depends upon the size of the object, and varies from twenty-four hours to two or three months. Fixation is carried out in the dark. Transfer the object to strong alcohol, without preliminary washing; here it hardens. When sufficiently hard pass through paraffin. Sections, freed from paraffin, are placed in the following stain: acetic acid sol. 2 per cent., 100 c. cm., rubin 0.25g., sat. aq. sol. picric acid 100c. cm. The picric acid remains in the nerve elements, and so affords a contrast to the neuroglia. The stain acts very energetically, a few seconds in it being sufficient. Wash in 95 per cent. alcohol, changed once. Excess of stain being thus removed, transfer to absolute alcohol, clear, mount as usual. The cells and fibres of the neuroglia are stained reddish-violet. Other elements are but slightly stained. If, however, the dye is used for more than a very brief time, nerve cells

and axis cylinders also acquire the stain. Sections must be very thin. More recently Kulshitzky has used the following stain: alcohol 96 per cent 100 parts, the above mentioned rubin solution 3 to 5 c. cm. With this the staining process is much lengthened (half hour or more), but sections are less apt to break up.

BACTERIOLOGY.

New Multiple Staining Fluid.—Dr. P. G. Unna differentiates bacilli in tissues by a polychromic methylene blue solution, which contains methylene red and violet, in addition to the blue. The sections are transferred from alcohol and allowed to remain in the stain for at least ten minutes. They are then passed through water into 33 per cent. tannic acid solution to decolorize, allowed to remain from two to five minutes, then rinsed with water to enable the exact tint to be observed more readily. If satisfactory, after a thorough washing with water the sections are placed in absolute alcohol, or a solution of gold orange in the same if a yellow counter stain be desired, cleared in oil of bergamot, and mounted in balsam. If the excess of stain is not readily removed, a few minutes immersion in 25 per cent. nitric acid, followed by dilute spirit, water, and absolute alcohol, respectively, will effect its removal. By adopting this method it is said to be possible to distinguish two kinds of nuclei (violet and blue), the fibrin, and the protoplasm of the plasma-cells. The bacilli stain red whilst the mucus surrounding them is blue, and the organisms are said to appear in their natural character "in fish-roe like masses of vegetable mucus." It is claimed that the process is particularly suitable for use in the study of leprosy. It appears to depend upon the property, also utilized by Nicolle, by which tannin converts methylene blue into an insoluble form.—*Druggists' Circular and Chemical Gazette*.

MEDICAL MICROSCOPY.

Trichinosis in Belgium.—In one town, 13 persons out of 39 affected, recently, died. Lard was found to contain enor-

mous numbers of the parasite. It was made from native and not imported hogs. This points to the eventual substitution of Cotton-seed oil for lard in cooking.

Bleeding Bread.—This affection which was epidemic in Europe seven years ago has made its appearance in England. Microscopic spherical cells filled with reddish oil give from a peach blossom to a blood color to the medium in which they grow. In the dark, the deposit extends itself by spurting a sort of jet or column of red particles, so that a large surface is covered with great rapidity. Treated with sulpho-iodine, it turns blue.

Bovine Tuberculosis.—The blooded Alderney stock of C. S. Taylor of Burlington, N. J., has been found to be affected by tuberculosis. Out of a herd of 150 cows, some 20 have already been killed and others are doomed, Mr. Taylor being determined to stamp out the disease.

Hydrophobia.—The Chicago Pasteur Institute in the preventive inoculations against hydrophobia has attained the following results since its inauguration, July 2, 1890:

To date 302 persons have been treated, classified as follows: 104 bitten by animals recognized and ascertained to be rabid by the experimental proof made in the laboratory; or by the death of other persons or animals bitten by the same animal; 126 bitten by animals recognized to be rabid by the symptoms of the disease shown during life; 72 bitten by animals strongly suspected to be rabid; 282 persons were bitten by dogs, 7 by horses, 7 by cats, 3 by skunks, 2 by wolves, 1 by a mule.

The persons treated came mostly from Illinois, Iowa, Indiana, Kansas, Ohio, Missouri and Arizona.

Only one death was reported among the patients treated, thus giving a mortality of about 0.33 per cent.

BIOLOGICAL NOTES.

Red Blood-Corpuscle.—Dr. Moser has concluded that the red blood-corpuscle has a distinct nucleus. He gave methylene blue to a patient internally in one-grain doses three times a day. He then examined the blood and found that nature had done the staining. The nuclei of the white blood-corpuscles were

stained blue. In the centre of the red blood-corpuscles was found a collection of protoplasm stained faintly but distinctly from the rest of the cell. Dr. Stowell was of opinion as far back as 1878 that the red blood-corpuscle had some body within it which was not unlike the nucleus of other cells. This he demonstrated by staining with a solution of eosin. The eosin stains the nucleus intensely red, while the remainder of the corpuscle is stained only slightly.

DIATOMS.

A New Book on Diatoms Proposed.—By request of the author, Dr. A. M. Edwards, we invite subscriptions to *Bacillaria*. It will contain a popular account of Diatoms in general and the mode of collecting and cleaning their shells. Illustrated, 100 pp. Price \$3. Club rates to our subscribers \$2.75. From this price a further allowance of 25 cents will be made to those who subscribe during December, payment to be made on publication of the volume.

MICROSCOPICAL SOCIETIES.

Essex County Society,—Montclair, N. J.

October 19, 1893.—The Annual Meeting was held at the residence of the Secretary, 88 Mountain Avenue, Montclair, N. J. The Officers elected for 1893-'94 were: Edward H. Hamill, M. D., of Newark, N. J., President; Frank Vanderpoel of Newark, N. J., Vice-President; Rev. F. B. Carter, of Montclair, N. J., Treasurer; C. M. Marvin, of Montclair, N. J., Secretary; Dr. Geo. S. Allan of Montclair, N. J., on the Executive Committee.

Peoria Scientific Association, Ill.

October 13, 1893.—The association met in the Court House. Harold Plowe spoke upon, "the Mechanism of the Microscope," and presented lantern illustrations. He showed the most noted microscopes and explained their mechanism. He also gave a display of slides some of the objects thrown on the screen being magnified, says a local paper, to "Many million times their actual size."

October 20, 1893.—Mr. Joseph Huber spoke on "Mounting

Objects for the Microscope," and illustrated it by the actual work of mounting some objects, and by objects being shown under the microscope. A number of instruments were loaned to him for the purpose.

At the next meeting a paper will be presented by Dr. O. B. Will, whose subject will be "Application of the Microscope."

Washington, D. C., Reported by L. M. Mooers, Secy.

November 14.—The meeting was one of much interest and there was a good attendance, several visitors being present. Dr. Robert Reyburn, with the aid of the stereopticon and screen, exhibited a large number of micro-photographs, chiefly histological, many of them being his own work. The comparative merits of wet and dry plates in this class of work were seen in the images on the screen, those made on wet plates being by far the clearest and sharpest. One of these slides representing the formation of pus, gave rise to an interesting discussion as to whether such formation results from the proliferation of the nuclei of the epithelial cells, or arises from a lower layer.

Dr. J. M. Lamb followed with a paper on bone formation, and some methods of preparing it for class demonstration. He exhibited finely prepared specimens of full sized bones sawn into thin sections, beautifully whitened and displayed. Dr. J. H. Rindlaub was elected a member of the Society.

NEW PUBLICATIONS.

Botanical Microtechnique, by Dr. A. Zimmermann. Translated by James Ellis Humphrey. 8° pp. 296. 63 figures. New York, 1893. Henry Holt & Company.

We have before us a very elaborate hand-book of methods for the preparation, staining, and microscopical investigation of vegetable structures. Dr. Zimmermann, who is a professor in the University of Tubingen, published this volume in 1891-2. Dr. Ellis has made important additions, in the English edition, in the way of notes and tables as well as in the text itself. He has deemed the translation necessary because, as he says, but few English speaking, elementary students read German readily. Assuming this deplorable fact to be true, we must incidentally interject a protest against the popular education of the day which permits such to be the case.

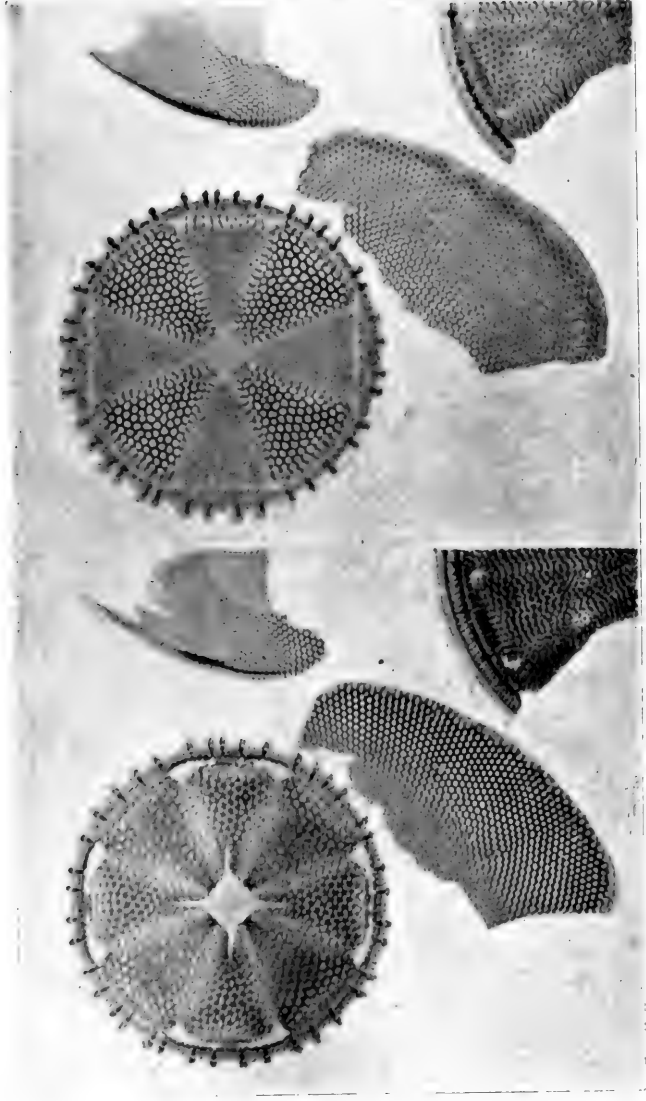
After devoting 40 pages to general methods, such as cutting, staining, clearing, and maceration, the microchemistry of organic and of inorganic compounds is treated in about 100 pages in the most thorough and exhaustive manner. One will be astonished, in looking it over, at the immense amount of knowledge of the subject that has been created in the past 25 years. The new words, which were not in any dictionary in 1860, must number several score. This research, as any one will see from the list of authorities cited in the appendix has been very largely made by the Germans.

A third part of the book (110 pp.) covers methods for investigation of the cell-wall and of the various cell-contents, especial attention being given to the protoplasm and cell-sap. Here we strike a perfect mine of useful and enchanting study. The ways of approach to the biologic problems of vegetable life are shown to be multifarious. So many new and enticing methods being given, must stimulate students to a general assault upon these questions lying at or near the origin of vegetal existence. Hereafter, one will need to publish his discoveries promptly or he will be antedated by others in the same field. Every chemist as well as every microscopist will find useful information in this volume which closes with a chapter on Bacteria and a fine index.

New Truths in Ophthalmology. By G. C. Savage, M. D. 8° square. 152 pp. 32 illustrations. Nashville, Tenn. Published by the Author.

Dr. Savage, who is Professor of Ophthalmology in the Medical Department of the University of Nashville and Vanderbilt University, is an acknowledged authority upon all matters relating to the eye. He has written this book for eye specialists and not for laymen. We are not competent, therefore, to criticise it but an oculist has assured us that this book constitutes the greatest contribution to the science of Ophthalmology that has appeared during the past twenty-years.

Mechanically the book is excellent, but we see no reason for adopting the square form. There are none of the illustrations but might have been engraved to fit the usual octavo page. A glossary of the many technical terms employed would help to make the book more intelligible even to the practicing physician and an index of three or four pages length would improve the book.



STEREOSCOPIC PHOTOMICROGRAPH OF HELIOPELTA AND BROKEN COSCINODISCUS.

Magnified 250 diameters with Bausch and Lomb 1.5 in. objective.

The slide tilted and the focus altered for each exposure.

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Stereoscopic Photomicrography.

BY DR. W. C. BORDEN, U. S. ARMY.

NEWPORT, R. I.

WITH FRONTISPIECE.

Stereoscopic photomicrographs are superior to ordinary photomicrographs for representing some microscopic objects. Their advantages are the representation of real form through the effect of relief, and the ability to present and combine into one image more than one focal plane of the object photographed.

It has been considered one of the disadvantages of a photomicrograph as compared with a drawing, that while the latter may be constructed so as to represent an object as it appears to the observer while successively viewed at different focal planes, the former pictures one focal plane only. It has been suggested that by a succession of exposures upon the same plate with the objective focussed differently for each exposure, a composite photograph could be built up which would represent the object with the truthfulness of photography and the pliability of drawing. This method, though widely exploited, fails utterly in practice; for a succession of sharp impressions of different planes of an object when superimposed produces no perfect image and gives only that appearance so familiarly known through examples of composite photography.

But by means of stereoscopic photomicrography the two most important planes of an object may be superimposed and combined so that a picture of the object having at the same time natural relief and sharpness is produced. To obtain this result the two negatives necessary for the stereoscopic picture are taken with reference to the production of stereoscopic effect and a different focus is used for each exposure.

I am not aware that this combination of changed focus and stereoscopic effect has ever before been suggested or practiced. Certainly, if it has, like the practice of stereoscopic photomicrography, it has not received the attention which its value demands.

It is not necessary here to enter into the theory of stereoscopic vision for aside from the theory of stereoscopy it is known that in ordinary stereoscopic photography full relief and sharpness is obtained in the combined image even if one of the pictures is blurred or indistinct. The sharp outlines of the good picture will override the somewhat blurred outlines of the poorer one while the combination of the two produces the impression of relief. This being the case, it would seem probable if a sharp impression of one plane of an object was obtained for one picture and a sharp impression of another plane for a second picture, provided the planes were not so widely separated but that the details of each still appeared, though blurred, in the other; that when these pictures were viewed through a stereoscope the sharp outlines of each would override the blurred outlines of the other and a single stereoscopic picture would be produced, presenting different planes of the object with sharpness and with true relief. In practice this is found to be the case. For instance, if an attempt is made to photograph a diatom like the *Actinopterychus undulatus*, it will be found that owing to the undulations of the diatom valve, no correct image of the entire diatom can be obtained at any single focus; for owing to the undulations of the valve, the parts which are sharp at the superficial focus are blurred at the deep focus, and vice versa. Two photomicrographs must be taken of such an object in order to properly picture it; and if these pictures are taken and viewed stereoscopically, a true image of the object in which all parts appear sharp and in relief will be obtained. The illustration for this article is from such a stereoscopic photomicrograph of a *Heliopelta* and broken *Coscinodiscus* valve. The right hand picture was taken with the surface of the *Heliopelta* and the edge of the broken *Coscinodiscus* in focus while the left hand picture was taken with the focus adjusted to the deeper markings of the same objects. Inspection of these pictures will show that the sectors of the *Heliopelta* and parts of the *Coscinodiscus* fragment which are sharp in one picture are blurred in the other; yet when viewed through the stereoscope all are sharp,

and the undulations of the *Heliopelta* and the curved shape of the *Coscinodiscus* are beautifully brought out. Of course, diatoms are not the only objects which can be equally beautifully pictured. Stereoscopic photomicrographs of injected animal tissues, which of necessity are cut rather thick, show the blood vessels in natural position instead of on a single plane as in ordinary photomicrographs. Insects, the rather thick sections of vegetable histology, crystals, and the many objects which require relief to give a proper conception of their form, are all best represented by this kind of photograph.

Stereoscopic photomicrographs may be taken in several ways—the end to be attained being to produce a result similar to that produced by ordinary binocular vision. In normal vision, the eyes being placed at some distance from each other, each gets a slightly different lateral impression of the object viewed and a combination of these impressions by mental processes produces the effect of relief. In stereoscopic photomicrography the necessary different lateral views of the object are obtained either by tilting the object or by using different halves of the objective for each view. In the first method, which is the one preferably to be adopted whenever practicable, the slide carrying the object is tilted on the microscope stage and a negative is taken, the slide is then tilted in the opposite direction and an exposure made on a second plate. In this way pictures are obtained of the object partially from opposite sides, as with the eyes in usual vision; and a combination of these pictures when viewed through a stereoscope gives stereoscopic effect. This effect is strictly analogous to that of binocular vision, for from the back and forth tilting of the object, the objective acts first as does one eye and then as the other. The point of view in both cases being not directly from the front but slightly from opposite sides.

Where stereoscopic effect is obtained by the use of different halves of the objective, the cause is different, though the resulting effect is practically always similar. This is due to the fact, which has been fully demonstrated by Professor Abbe, that in an aplanatic system pencils of different obliquities yield identical images of every plane object, and that there is a parallel projection of all the successive layers in one common plane perpendicular to the axis of the microscope. There is, therefore,

no perspective and the stereoscopic effect produced by the use of one-half the objective is due, not to differing lateral views of the object, but to the lateral displacement of the images of consecutive layers effected by the oblique pencils employed. In effect the lateral displacement of the images of successive layers is similar to that produced by differing lateral views of the object, and pictures so obtained are not only stereoscopic but they are true representations of the object viewed. The utilization of one-half the objective is similar to the process employed for obtaining stereoscopic effect in binocular microscopic vision, where, by the use of a prism in the tube of the microscope, the rays from the right half of the objective are projected to the left eye and the rays from the left half are sent to the right eye.

When using this method for stereoscopic photomicrography, either one-half the front of the objective or one-half the back is covered, but in either case the covering must *fit close* against the glass of the objective. A cap covering one-half the front of the objective may be fitted to objectives up to one-fifth inch focus, but objectives of higher power can not be capped in this way as their working distance is too short. With low power objectives, in fact with all powers which have sufficient working distance to allow focussing after tilting the slide, it is best not to cap the objective but to use the full objective and get the desired stereoscopic effect by tilting the slide. In this way the objective is worked to its best advantage and the lateral views of the object are real and not due to optical displacement of its different planes. Also, when the lens is capped, it is impossible to even illuminate a large field and this is the great disadvantage as it restricts one to the use of a small central field. In tilting the slide, *the axis of the tilt must be parallel with the upright axis of the object*, and this axis must be maintained when the pictures are mounted on the stereoscopic card. That is, if the object photographed is an insect so mounted that its head points upward when the microscope is horizontal for photography, then the slide must be tilted from the end and the photographs of the insect must be mounted with the head of the insect toward either the top or bottom of the card. If, however, the insect is lengthwise of the slide, the slide must be tilted from the side if the picture of the insect is to be mounted head up or down. It is not strictly necessary to tilt the object for both exposures and

if it is more convenient, the same result may be obtained by taking one negative with the slide flat on the stage and the other with one side or one end of the slide raised. But if only one side or end is raised, it must be raised twice as much as each side or end would have to be if raised alternately. With objectives of from one to one-fifth inch focus, the ends of a slide should be raised alternately a little less than one-eighth of an inch; or if the axis of tilt is to be parallel with the long axis of the slide, the edge of the slide should be raised a little less than one-sixteenth of an inch.

When but one-half of the objective is used, one exposure is made with one-half the front or back of the objectives covered and the second exposure is made with the opposite half covered. In mounting the pictures from these negatives, their upright axis must be parallel with the surface of the hemisphere of the objective and as the microscopic image is inverted, the picture taken with the right half of the lens must be mounted so that it will be viewed by the left eye and that taken with the left half with the right eye. In mounting pictures taken with the slide tilted, the one taken with the right end of the slide raised corresponds to that taken with the right half of the objective and should be mounted to be viewed by the left eye. If the pictures are inversely mounted, pseudoscopic, instead of stereoscopic, effect will be produced. The pictures should not be more than two and three-fourth inches in width. They must correspond; and that they may do so, a good way is to place the two pictures together, and while viewing them by transmitted light so placed one above the other that the like parts of the pictures accurately cover each other, then while they are held in this position they can be cut together to the required size.

The range of the usefulness of stereoscopic photo-micrography is mainly below amplifications of 300 diameters, but within this limit there is large opportunity for its advantageous use in realistic, if the term may be used, photographic representation of many objects of scientific interest.

Brain Matter—The nervous matter of the brain and spinal column appears to the anatomist and to the microscopist as exactly alike in every healthy human being but it is believed that there must be invisible differences corresponding to the difference between the mind of Gladstone and that of a mere beggar.

The Action of Leucocytes Toward Foreign Material.

BY EDITH J. CLAYPOLE.

AKRON, OHIO.

In this paper the results of some experiments made in the laboratory of Professor Gage of Cornell University, during the past year are briefly set forth. The object of the experiments was twofold. In the first place, to discover if possible the ultimate fate of at least part of the great number of leucocytes that in the animal body continually pass away from the circulation, and in the second place to find what part the leucocytes play in the removal of foreign material from the body.

In considering this second point the nature of the leucocytes as entities in the economy of the animal system is of especial importance. The Phagocyte Theory of the great Russian morphologist, Metschnikoff, is based on one of their peculiar powers, that of taking up foreign material by virtue of their amoeboid movement. These cells form the guardian army of the body. They stand ever ready to ingest and remove all foreign substances that enter the system, and on their ability to do so depends, to some extent at least, the health of the animal. If the invading forces are too strong, the animal becomes sick or perhaps dies, but if victory is with the leucocytes normal conditions are again established.

It is not necessary, however, for the contest to become apparent. It is continually taking place, often giving no external evidence of its existence.

Such is the Phagocyte doctrine as its founder taught it. As in other cases of wide generalizations, these extreme views have not been adopted by all. Those belonging to the more conservative party consider the protective part played by the leucocytes as small or merely incidental. The fact of the ingestion of the foreign material remains established, however, and on the strength of this knowledge the following experiments were made, the results of which are briefly presented.

Under as nearly normal circumstances as possible, a small quantity (4-1 c. cm.) of a mixture of lamp-black and gum arabic suspended in normal salt solution, was hypodermically injected into the abdominal cavities of the salamanders, *Necturus maculatus* (Mud-puppy) and *Cryptobranchus alleganiensis* (Hell-

bender). In these animals the abdominal cavity forms a great lymph space, the leucocytes in the lymph ingest the carbon and then pass into the blood circulation with the passage of the lymph. The time required for this varied from 6-9 days. In *Necturus*, owing to the presence of external gills the time of the appearance and disappearance of the carbon could be determined with fair accuracy. In 6-9 days carbon-laden cells appeared in the blood and even after 16 days a few scattered ones remained.

In the microscopical examination of the tissues, the presence of large masses of natural black pigment was a great difficulty. After some experimentation this was found to be easily removed by the use of hydrogen dioxide. The serial sections, when cut and fastened to the slide, were put in a vial of the liquid and in from 6-48 hours the color was entirely removed. By placing the vials in the sunlight the action is hastened. The decolorization can be stopped at any point and it was found to be very useful to leave enough yellow color to mark the position of the pigment cells.

The study of serial sections of the different parts, showed the ingested cells to be present in the spleen, kidneys, ureters, liver, lungs, stomach, muscle and skin. The distribution differed somewhat in these parts. In the liver no ingested cells occurred outside the blood vessels. In the kidneys they were in the blood vessels, urinary tubercles, nephrostomes and lymph spaces about the glomeruli. In sections made of the ureters close to their entrance into the cloaca, large masses of ingested cells were present. In the stomach, lungs, and skin substantially the same distribution existed. The carbon-laden leucocytes were in the blood vessels, in the various tissues of the different organs, in the epithelial and epidermal layers and finally free on the inner surface of the stomach and lungs, and on the outer surface of the skin. No trace of free carbon or carbon in any cells besides leucocytes appeared in these parts.

But when the spleen is considered some very interesting differences become apparent. Here the true spleen cells also contain carbon scattered about in the cell-body in quite a peculiar way. At first sight, owing to the extended condition of the cells, the carbon appeared to be free in the tissues, but careful examination proved it to be in the spleen-cells.

As a result of the experiments the following facts were established.

1. No *free* carbon was anywhere present.
2. All carbon was contained in leucocytes and true spleen-pulp cells.
3. Ingested cells were free on mucous and epidermic surfaces.
4. Ingested cells were in excretory organs with waste products.

From these facts it may be concluded that leucocytes are lost from the body in 3 ways: by wandering out on mucous and epidermic surfaces; by passing away with waste products; by ingestion, by splenic cells. Since the animals experimented upon were kept in normal conditions and, so far as known, no pathological conditions subsequently supervened, this loss can be considered as a usual occurrence. The removal of the carbon in this way suggests the method of the removal of any foreign material of a like or even of a dissimilar nature that may chance to come into the circulation of the animal. Thus the leucocytes truly become the scavengers of the body.

To Mount Certain Salts.

By NO SIG.

PARIS.

(Continued from page 261.)

II. TO CLEAR SPOILED SLIDES.

Before describing the manner of making a preparation of the next salt it will be as well to give the best way of cleaning off the spoilt slides and getting them in a fit state to use again, as you will find that there is sure to be a great many spoilt in their preparation at the different stages, and as it is not worth while to preserve any but pretty perfect specimens, it is better to get them cleaned off as soon as possible to prevent accumulation.

If the slide, after warming does not give a characteristic and good specimen of crystals, the salt should be scraped off with a blunt pocket knife and placed in a flat dish under water at once. Many salts, if left for long on the glass, seem to eat into the surface and show the shape of the deposit when you breath on the glass, even after having been thoroughly cleaned. Where

this is the case, you can never get a solution to spread properly over the slide as though it were greasy. The only thing is to use the other side, if clean enough, or if both sides are bad, the glass can serve for any ordinary slide, the spot only being seen when breathed upon. If the spoilt preparation was mounted in balsam or any other medium, the slide should be warmed on the hot plate, until the cover can be slipped off by the knife. Then scrape off all the balsam you can, and clean the rest off with methyl alcohol, putting the glasses as before under water.

If the slides have had a ring made with asphalt or any other varnish, it will be necessary to carefully scrape it all off with a knife. Heat will not soften it.

The covers can be dropped into a bottle containing methyl alcohol for cleaning at leisure.

When you have a batch of glasses ready for washing, put them in a pretty strong solution of washing soda, leaving them in it about twenty-four hours, thoroughly rinse in clean water, rubbing the glasses well with the thumb, changing the water occasionally. When sufficiently rinsed rub dry with a clean cloth, using the first one to dry and another to polish. The slides, when put away, should be wrapped up in soft paper to keep them clean. When quite dry, breath on them to see that they are thoroughly cleaned. Those slides not sufficiently clean should be put at one side for another treatment with soda, it frequently happening that they have not been properly subjected to the action of the soda from lying closely one on the other.

Those glasses that are clean should be wrapped up in soft paper to make a packet from which you can always be sure of getting a slide fit for use.

III.—TARTRATE OF SODA.

To prepare slides of tartrate of soda, it is necessary to make the solution yourself. I have found, on attempting to use the crystals of tartrate of soda as purchased, that they yield a different and very insignificant form. Make a strong solution of tartaric acid and carefully neutralize with carbonate of soda. When the solution becomes solid add a little distilled water to dissolve the precipitate, allow to settle, when it will be ready for service. Now, I usually with all the solutions al-

low them a day to settle, as with the small quantities that you use, it is very difficult to filter without losing the greater part by absorption, which necessitates making a much larger quantity than is necessary.

Take a clean slide and place it in the card-board guide and drop a small quantity of the solution of tartrate of soda in the centre as near as possible, with a small pipette; have the hot plate heated beforehand, the flame of the spirit lamp being about two inches from the brass plate; place the slide on the hot plate and leave it about a quarter of an hour to thoroughly heat. It will dry to a thin film-like gelatin. No sign of crystallization appearing, place in a position to be free from dust and examine every day so as to observe when crystallization commences. In about three days you will perceive some small discs on different parts, which after the lapse of a few more days will spread over the whole of the film. I have tried mounting some before the crystallization had covered the whole of the slide, as I thought they looked more brilliant when a portion of the ground was seen, but found that after a few days the crystallization had spread over the whole space, although they were mounted in castor oil.

This is a very handsome preparation and is well worthy of a place in the cabinet. The discs are very similar to, and as brilliant as Salicine, showing well the cross, and being much improved by the selenite film.

Castor oil is the best general medium by far for mounting crystals in. I have not yet found any salts that are affected by it, unless a lengthened time may cause some change. I have not found it easy to get rid of air-bubbles in the case of crystals that contain interstices, but will try what the air-pump will do in this case.

It is very easy to use and to seal up, and never contains air-bubbles in itself as balsam frequently does. I press a couple of drops from the tube and lay the cleaned glass cover carefully on the side that contains the highest ridge, so as to make sure of not including any air; clip the slide, and remove the excess of oil with a soft brush, being careful not to let the hairs get under the cover. Wipe the brush from time to time on a bit of blotting paper or rag. When the bulk of the oil is removed, dip the brush in alcohol and clean as much off as possible. On

looking near the edge of the cover with a magnifying glass you will see that the oil is collected in very small spots dotted about, leaving the greater part of the slide free from oil, the cover, of course, being quite clean. Take off the slip and centre the slide on the turn-table as perfectly as possible, and then turn a ring of red sealing-wax varnish. On looking at the under part of the slide, you will see that it has made a perfect ring. In a day or two the slide will be ready for a coat of black asphalt or any other tough varnish, as the sealing-wax is likely to become brittle with age.

Gold-size has been recommended for sealing liquid preparations, but it takes so long a time to dry (I find it still tacky after three months, although I have a sample more than ten years old). So that it is better to use sealing-wax varnish in all such cases where the cell contains no liquid that will attract the lacquer.

I am indebted for the means of forming this salt to Davies' work on mounting.

(To be continued.)

A Remarkable Collection of Photo-Micrographs.

By K. M. CUNNINGHAM,

MOBILE, ALABAMA.

Having recently, by a casual circumstance, had my attention called to some microscopical work done by a physician re-iding in Mobile in the decade comprised between the years 1860 and 1870, and on account of the interesting variety of subjects treated, and the period and circumstances of their production, I have regarded the matter as of sufficient interest to submit the information for publication in your Journal in the hope that it may interest your readers.

For the epoch noted above, Surgeon-General Woodward, U. S. A., had probably the greatest renown as an enthusiast in developing a wide spread interest in the study of the diatom, through its various resolutions by means of perfected lens systems, and microphotographic appliances. Those who visited the Centennial Exposition at Philadelphia, may recall the magnificent collection of collodion positives exhibiting the colossal plates of the Surgeon General's skill in the resolution of lined objects and

their enlargement, but after 33 years, evidence is brought to light of a quiet worker, whose work would possibly divide our admiration and wonder, could the specimens be juxtaposed for inspection. The collection consists of sixty-five silver prints of a uniform diameter of six inches each, mounted on a page of the album, which is about twelve inches square.

All of the negatives of these prints, must have been prepared on wet, or collodion plates; as the dry plate of to day, was not known in 1860. The only information that the album gives in relation to the work, is found traced on the negative with a pin and reads Dr. Herapath's $\frac{1}{4}$ inch lens, "Ross," April 25, 1860.

After more than 30 years the silver prints are in a fair state of distinctness, some are slightly faded, while others are perfectly preserved. Another circumstance recalled is that they must have been taken by sunlight, and in the daytime alone; both of the methods alluded to are now most generally superseded by dry plates, lamp and electric light, and work mostly done at night. Dr. Henderson rested from his earthly labors a number of years ago, and before the era of the modern Microscopical Journal made it possible for workers to interchange or become aware of each others varied lines of work, or to introduce them to the mead of admiration that would have welcomed them in the circle of the sciences.

Dr. Henderson in every case wrote down the times magnified as well as the number of diameters, a few characteristic specimens of this rotation are given in the list herewith.

LIST OF MICRO-PHOTOGRAPHS TRANSCRIBED FROM AN ALBUM OF
SILVER PRINTS PREPARED BY DR. HENDERSON, AT
MOBILE, ALA., ABOUT THE YEAR 1860.

Specimens derived from insect or parasitic life.

Leaf or scale insect (not named), 120.

Scales of *Lepisma saccharina*, 120.

Spiral vessels in stomach of house fly, 120.

Leg and claw of spider, 80.

Spiracle of *Dysticus marginalis* (Water Beetle), 84.

Larva of the Breeze fly in egg, 120.

Acarus scabiei, or Itch mite, 230.

Trachea of Caterpillar, 80.

Foot of House fly, 120.

Proboscis of Bee, 120.

Acarus of Xyclope, 120.

Proboscis of Blow fly, 40.

Parasite of *Sorex araneus*, 120.

Specimens of Diatoms.

Orthosira dikiiei in fission, 1,000.

Gomphonema geminatum, 1,200 (6 inches long).

Arachnoidiscus, four shells, 120.

Arachnoidiscus, one shell (6 inches across), 408.

Portion of same, near center, 2162.

Portion of same, near margin, 2064.

Actynoptychus undulatus (var), 750.

Actynoptychus (portion of same), 3780 (14,288,400 times magnified).

Actynoptychus (portion of same), 22,680 (514,372,400 times magnified).

Eupodiscus, fossil from Bermuda, 1,040.

Coscinodiscus oculosiridis, 480 (5 inches across).

Triceratium favus from the Thames, Lambeth, 1104 (4½ inches a side).

Pleurosigma formosum, 4320.

Navicula didyma, 1800 (5 inches long).

Auliscus sculptus, 1800 (5½ inches across).

Dictyocha fibula, 1800.

Pleurosigma angulatum, 4320 (18,662,400 times magnified showing 21 lines to 2 inches width).

Pleurosigma angulatum, 14,400 (207,360,000 times magnified 20 lines to 5½ inches).

Pleurosigma elongatum, 4320.

Pleurosigma elongatum, 51,840, (2,687,385,600 Times magnified 16 lines in 5½ inches of foot rule).

Pleurosigma elongatum, 155,520 (24,186,470,400 Times magnified 5 lines to 5½ inches of foot rule).

Isthmia nervosa, on sea weed, 120.

Isthmia enervis, on sea weed, 120.

Campylodiscus clypeus, Franzenbad Bohemia, 120.

Specimens from plant life.

Raphides or crystals in skin of garlic, 250.

Raphides or crystals in skin of garlic, 1,200.

Stomata on under leaf of Box, 900.

Section of stem of Aloe, 40.

Transverse section of Birch, 40.

Longitudinal section of Spruce, 40.

Stellate, sciliceous hairs from leaf of *Dentzia scabra*, 120.

Lower epidermis of *Galium mollugo*, 120.

Chara (globule extruding spores), 150.

- Spores and elaters of *Marchantia polymorpha*, 120.
 Spores and scales of *Aerostichum alicorne*, 40.
Ceramium acanthonotum (sea weed), 40.
Callethamnion (Tetraspores in swollen ramule), 40.
Micrasterias lobata (desmid), 120.
 Hair of *Ornithorynchus*, 120.

Specimens from sea life.

- Laguncula repens* (colony) Polyzoa, 40.
Campanularia (colony), 40.
Anguinaria spatulata, Polyzoa.
 Spines and pedicellaria of star fish, 4 species in 4 prints, 40.

Histological specimens.

- Injected small intestine of Hedge hog, 40.
 Longitudinal section of child's tongue (injected), 40.
 Blood vessels in the brain of a Hare, 40.
 Section of human scalp (injected), 40.

Something About Sponges.

By A. CHOPIN,

MANCHESTER.

The history of the sponge is a very peculiar one; for centuries a controversy raged between zoologists and botanists, both claiming it for their respective kingdoms, the sponges then holding the position now occupied by our favorite *Volvox*. We first hear of them scientifically about 330 B. C., when Aristotle, in some of his writings spoke of them as animals endowed to a certain extent with the senses of hearing and seeing. In others of his works he considers them as vegetables, but seems to conclude that they belong to both animal and vegetable kingdoms, and are animal-plants. Some 400 years later, Pliny classed them as animals, and even spoke of them as having sensible life, and that they possess blood. He also tells us of some writers who can distinguish them as males and females. From the time of Pliny to the middle of the 18th century botanists seem to have had the pull of the rope, Gerarde, Ray and Marsigli amongst them would not hear of the sponges being animals, although the latter saw 1710 contraction and dilatation of the oscula of some sponges. Linne, in 1770, classified them amongst the *Cryptogamous algae*. About this time Trembly, Ellis and others took up

the fight for the zoologists; then came the tug of war. The greatest pull was given for the latter party by Grant in 1825, who, having put a small sponge in a watch-glass full of sea-water and looked at it with a microscope, said: "I beheld for the first time the splendid spectacle of a living fountain vomiting forth from a circular cavity an impetuous torrent of liquid matter, and hurling along in rapid succession opaque masses which it strewed everywhere around. The beauty and novelty of such a scene in the animal kingdom long arrested my attention." From that time to a few years ago the botanists gradually relinquished the sponges, Hogg being the last who did battle for them in 1868.

The sponges are now universally acknowledged as animals, but their position in the animal kingdom is still a matter of controversy, some following Saville Kent (not accepting their true sexual reproduction) claim them as Protozoa and class them among the Choanoflagellata, others regard them as Metazoa, some with Haeckel, as Cœlenterata, some with Schulze and Polejaeff as having branched off from the Cœlenterata at an early stage, whilst others with Marshall regard them as degenerate Cœlenterates having at one time possessed tentacles, nematocysts and mesenteric pouches. By Balfour and Sollas they are regarded as an *independent phylum or special division* of the Metazoa.

We will now consider a single sponge, say an *Ascetia*. Here we have a hollow sac-like organism attached by one end to a fixed object, while at the other end is a large aperture, the *osculum* or vent. At the sides are numerous small apertures, the *pores* which lead to the central cavity, the *paragaster*. The thin walls are composed of an outer layer of cells, the *ectoderm*, which is a pavement epithelium; of the inner layer of cells, the *endoderm*, composed of cells resembling the Choanoflagellata, each having a circular funnel-like collar and a long whip or flagellum; each of the cells besides a nucleus, has one or more contracting vacuoles which are supposed to secrete water, urea and carbonic acid. Between these two layers of cells is a third, the *Mesoderm*, composed of different amœboid cells, some leading as it were an independent life, wandering from one place to another at will. By the constant vibration of the flagella of the endoderm a current of water carrying small Infusoria, Diatoms,

and other small organisms, together with oxygen in a state of solution, is made to enter the pores, it then passes through the paragaster, where it parts with its food and oxygen, and takes up all effete and useless matter, which it carries away by the osculum. The walls of our sponge are strengthened by a skeleton of three-rayed spicules composed of carbonate of lime. Had our *Ascetta* a row of tentacles and no pores it would have all the appearance of a Hydrozoon, but unlike the Hydrozoon it possesses a third layer of cells, the mesoderm, and has no nematocysts. The choanoflagellate endoderm is also characteristic of the Infusoria and not of the Coelenterata.

All the sponges, except a few genera like *Halisarca*, have a skeleton composed of calcareous or siliceous spicules, or of horny fibres. Sometime the fibres enclose siliceous spicules or foreign matter, such as grains of sand, or debris of shells, etc.

The calcareous spicules are composed of carbonate of lime, having all the properties of calcite, each spicule being a simple crystal, although its form and general structure are purely organic. The siliceous spicules are composed of colloid silica, and therefore can be distinguished from the calcareous spicules by the application of polarized light, which has no influence upon them. Sponge spicules differ greatly in form and size, and can be divided into two groups, the microscleres or flesh spicules, which support only a single cell, and the megascleres or skeletal spicules, which support the whole sponge. Except in few cases they can be distinguished from each other by their size.

Spongin is a horny substance having the chemical composition of silk; it generally takes the form of fibres consisting of a central core of soft granular substance around which the spongin is deposited in concentric layers; in some species the fibres have the form of antlers; in others they resemble the branches of a tree, whilst in others they anastomose as in *Euspongia officinalis*, and form a kind of network. In each species the fibres differ, and this is made use of for classification.

The histology of the Porifera is very interesting. The ectoderm, except in few species, consists of pavement epithelial cells pinnacocytes, in the few exceptions it is locally replaced by columnar epithelium. The endoderm is of the same character as the ectoderm except in the Ascon, and in the flagellated chambers of all other sponges where it is formed of collared

flagellated cells (*choanocytes*) in which a nucleus, a nucleolus, and one or more contractile vacuoles may be seen. It is worthy of remark that the flagellated chambers and the choanocytes become smaller as we advance to a more complicated canal system, thus in the simple *Sycon* the chambers are the largest; they become smaller at each step, until in the diplodal *Rhagon* they are the smallest.

In most sponges the mesoderm is largely developed; in its commonest and simplest form it consists of a clear, colourless, gelatinous matrix, in which irregular branching stellate cells or connective tissue corpuscles are embedded. The tissue is called collenchyme and the cells collencytes. In the higher sponges it consists of small, polygonal, granular cells, cemented together by a small quantity of structureless jelly; this is called the sarcenchyme. Scattered amongst the collenchyme are wandering amœboid cells, archæocytes, some serving as carriers of food, others acting as scavengers, carrying away all useless or irritant foreign matter; some of these cells become converted into sexual products. Another tissue, cystenchyme, is found in many of the higher sponges, especially in *Tetractinellida*. It consists of closely adjacent, large, oval cells with thin walls and fluid contents; near the centre of the cell is the nucleus and its nucleolus, it forms a layer just below the skin of such sponges as *Pachymatisma*, and is supposed to be a fatty tissue, for, in teasing out a piece of the cortex in water, oily globules are set free. This oil must be soluble in alcohol, for sponges which have been kept in spirit show no trace of it. *Chondrenchyme* is a tissue which resembles cartilage; it is found in the *Corticidæ*. Connective tissue cell, desmacytes, are present in most sponges. Being closely packed together they sometimes form a kind of felted sheet, which in the ectosome of some sponges acquires a considerable thickness, often constituting the greater part of the cortex. The stereasters of *Pachymatisma* are united together by these cells. Contractile fibre cells, myocytes, occur in all higher sponges. These are fine, granular, fusiform cells, with long filiform terminations. In most sponges the incurrent and excurrent canals are constricted at intervals by a muscular sphincter produced by the excessive development of myocytes. Their functions can be easily demonstrated, for irritation of the margin of the osculum of such sponge as *Pachymatisma* is fol-

lowed after a rather short time by the closure of the sphincter.

Supposed sense cells, *æsthacytes*, have been observed by Stewart and have been described by Lendenfeld, they are spindle shaped, one end projects through the epithelial ectoderm, the other end becomes continuous with cells that Lendenfeld supposed to be multipolar ganglion cells. Other cells the same observer regards as nerve cells and muscular cells, but these have not as yet been sufficiently studied. Pigment cells are generally distributed throughout the sponges, but more especially below the ectoderm.

Each spicule of a sponge originates in a single cell, the *scleroblast*. When the spicule has completed its full growth the cell atrophies. During its growth the spicule slowly passes from the interior to the exterior of the sponge, and is finally (in at least some sponges, *Geodia*, *Stellata*), cast out as a effete product. The horny fibres of the *Keratosa* are produced as the secretion of cells known as sponginblasts, which as a continuous mantle surrounds each growing fibre, and cover each growing point in a thick cap. The lateral sponginblasts are elongated radially to the fibre; the terminal sponginblasts are polygonal and depressed, the latter giving rise to the soft granular core, and the former to the spongin wall of the fibre.

New individuals are produced asexually by both internal and external gemmation, by fission, and by sexual reproduction. Fission is probably one of the processes by which compound sponges are produced from simple individuals. External gemmation has been observed in different species. A mass of indifferant sponge cells accumulate at some point beneath the skin, bulges out, drops off, and gives rise to a new individual. Internal gemmation, which results in the formation of statoblasts (or gemmules) is only known to occur in fresh-water sponges (*Spongillidæ*). These statoblasts are formed at the approach of winter in cold climates, or at the approach of drought in warm climates. They consist of a mass of yolk bearing mesoderm cells, invested by a double capsule, at the side of which is a small aperture, the hilum. The walls of the capsule are supported by small siliceous spicules called *Amphidisks*. In spring time, or at the return of the wet season, the interior cells creep out through the hilum, and by differentiation give rise to a young spongilla.

Both sexual elements may be found in the same individual sponge, but even in hermaphrodites either the male or the female element is in excess of the other; in some species the sexes are quite distinct. The ova developed from Archæocytes or wandering amœboid cells, which increase in size and acquire a store of reserve nourishment in the form of yoke granules. At first they exhibit amœboid movements, but as they increase in size they come to a resting stage. In *Euspongia officinalis* the ova occur congregated in groups within the mesoderm, thus presenting an early form of ovary.

A New Sub-Stage.

By GEO. WHITFIELD BROWN JR.

NEW YORK.

It was about B. C. 977 that "The Preacher" asked, "Is there anything whereof it may be said, See, this is new?" (Eccl. I, 10). Novelty has so often been honestly though mistakenly claimed, that I hesitated about the adjective in the above caption; but, if forgotten by the reader, I feel that he should be willing to be reminded of a good thing. And I am quite sure this sub-stage is a good thing for I have had one in continual use for nearly a year now, and speak only whereof I know. The sub-stage is scarcely second in importance to the stage itself of any first-class instrument, in the judgment of Dr. Dallinger (Carpenter, p. 169), and an efficient and economical one is certainly a great desideratum with any worker.

The one now described and illustrated is fully shown actual size in the accompanying drawing, partly perspective and partly sectional, and its construction and operation can be therefrom easily ascertained, aided by a few words of explanation. It was made for me by Zentmayer of Philadelphia according to my specifications and has given perfect satisfaction. In Fig. 1 the bracket L, sliding on the tail-piece or moved by rack and pinion, is the usual support of a sub-stage properly so called. The sub-stage itself is secured thereon by a centering set-screw J, and consists substantially of a double elbow with two arms, A and B, each carrying a similar tubular holder for receiving accessory apparatus, the former from above and the latter from below. In the space between the upper and lower holders is situated a

removable iris diaphragm or any substituted apparatus. The lower arm in this specific instance is provided with a revolving plate G, upon which there is a sliding plate F, moved by rack and pinion H, to receive the iris diaphragm and impart rotation and excentric movements in the usual ways. The iris diaphragm E, is provided around its inner periphery with a short flange nicely fitting within the central opening in the sliding plate F, and on the bottom just outside the flange with a pin, slightly shorter than the flange, which drops into a correspond-hole in the sliding plate F and secures the diaphragm in proper position. This pin may be duplicated opposite to render assur-

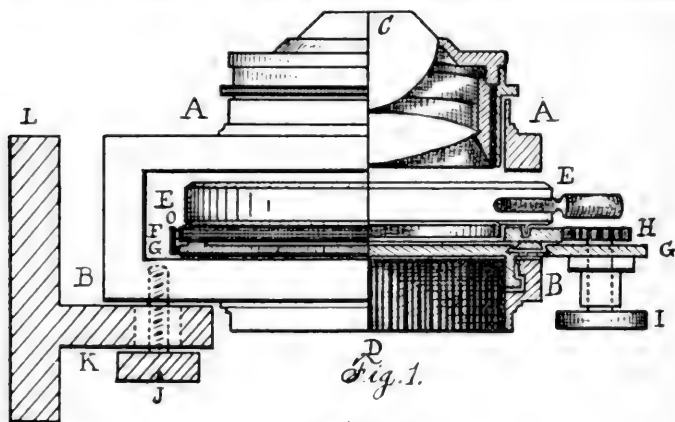


Fig. 2.



ance doubly sure. In operation the iris diaphragm is simply lifted up from its seat in the sliding plate and withdrawn entirely from the sub-stage, leaving its position free to be filled, for example, with the revolving apparatus shown in Fig. 2, wherein the sliding plate F is indicated in central section holding the revolving receiver N, and this in its turn holding another, M. In practice, N is slipped into place, and then M into its place; when either or both can be revolved in the same or opposite directions; in removal, M is first lifted up and withdrawn, and then N. It is obvious that various selenites, mica plates, diaphragms, etc., can be used in these revolvers very easily and advantageously. Here is, for one thing, a complete and practi-

cal selenite stage, in a compact and desirable position, between the condenser above and the polarizer below, all in close conjunction. For other things, more than can be enumerated now, workers will find the space between the upper and lower holders of this sub-stage both available and useful.

To sum up shortly, it seems to me that a sub-stage so arranged and constructed offers several advantages; it does away with swinging out to one side the iris diaphragm for any purpose, thereby putting extra weight and leverage on that side and incurring strain to working parts; it preserves a constant balance of all weights about the lines of motion; it allows convenient removal and replacement of the diaphragm; it permits the substitution of other apparatus instead of the diaphragm; it can be exactly centered in the optic axis; it is simple, efficient and inexpensive.

I should note, perhaps, that in the above description I have had in mind the iris diaphragm as made by Zeiss and sold separately; I have also shown in the drawing the Abbe condenser system, as furnished in its mounts by Zeiss, fitted into a jacket entering the holder from above instead of below as is customary with that maker.

The only objections that I imagine can be raised to this sub-stage are that the iris diaphragm is not in closer contact with the condenser, and that the manipulation of the inserted apparatus is delicate. The first objection I consider theoretical rather than practical as actual measurements will demonstrate that a construction which contemplates swinging aside the carrier and diaphragm must allow sufficient space for free passage, and the operation of withdrawing and replacing the diaphragm as described requires scarcely, if any, more space than usually allowed for the former operation. The second objection is subjective and probably can only be cured by education. There will always be people who use sledge hammers to kill mosquitoes, just as there will always be microscopists who want the stages of their 'scopes large and strong enough to serve as platforms on which to stand and deliver dissertations on its construction. Nevertheless to all interested I submit this modified sub-stage for trial and judgment in the belief that fulness of perfection is attained in time only by aid of attempted individual contributions, good, bad and indifferent, to that end.

Preserving Objects of Natural History: Microscopical Objects.

BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

The editor of one of the natural history magazines says that he "wants alcoholic specimens."

Now whilst I could send him alcoholic specimens of natural history in quantity, I wish to say something about the use of alcohol in preserving such objects. I do not use alcohol at all; except for drinking in the shape of wine, whiskey and beer. But I preserve specimens of natural history by a better and cheaper mode. I do not use alcohol; first, because it is dear; second, because it evaporates; and, lastly, because it contracts objects immersed in it and renders them colorless. Besides it is not a good preservative. I have found, to my sorrow, the snakes immersed in alcohol, and strong alcohol at that, after a time fell to pieces. Insects it does pretty well with, and animals will keep in it. But I use a watery solution of true salicylic acid. When I speak of true salicylic acid I do not mean the salicylic acid that is made from carbolic acid, for that is unstable and cannot be used in preserving objects of natural history, nor in medicine in which salicylic acid is so useful curing rheumatism. True salicylic acid is made of oil of wintergreen, and is in white, silky needles. Artificial salicylic acid is opaque and a mass of white minute crystals; besides it does not taste the same as the true acid. It is barely soluable in water and I use a solution in water as a preservative. It is cheap, also, much cheaper than alcohol. It does not evaporate, and, although it freezes in winter, whilst alcohol does not, this is a minor objection to its employment. Besides it does not render the objects immersed in it opaque. It keeps some colors, likewise it is anti-parasitic and destroys bacteria; besides, it is not poisonous. Since I first used it, fifteen years ago, I have never had a failure. It preserves the most delicate objects. Bacillariacea (Diatomacea) are preserved well in it, and other microscopic objects also. Watery solution of carbolic acid may be used, but that is poisonous and smells badly, whilst salicylic is odorless. I think it will recommend itself to all who use it, and I should like it tried. But remember that

true salicylic acid is the thing meant and not commercial salicylic acid. Natural history specimens, and microscopic specimens also, can readily be preserved in salicylic acid solution and for any length of time. Those I put up fifteen years ago are good yet and do not bleach as those in alcohol do. I wish others would try it and report results.

EDITORIAL.

Proceedings of the American Microscopical Society.—We are in receipt of the October part of Vol. XV of the publications of this society. The principal part of this issue (pages 39-76) is taken up by the prize essay of Miss Edith J. Claypole upon "The Blood of *Necturus* and *Cryptobranchus*." Six plates and a Bibliography accompany this paper which will prove of interest to those who study coagulation or blood corpuscles. A summary of the paper will be found in our Department of Biological Notes.

The address of the president, Hon. J. D. Cox, entitled "a plea for systematic instruction in the technique of the microscope at the University," occupies 16 pages and the secretary's journal of daily proceedings occupies 21 pages.

Short papers by Dr. V. A. Moore and P. A. Fish close this issue which, we are sorry to say, is not of as much interest as the corresponding number of 1892. There seems to have been but a dozen or twenty members present at Madison and only six or seven papers were actually read, the others being presented by title.

No prizes are offered for the coming year, and the time and place of meeting are left for future consideration.

We hope the next meeting will prove more successful.

MICROSCOPICAL APPARATUS.

Recent Advances in Microscopical Apparatus.—We are in receipt of the new catalogue of Bausch and Lomb and note many distinctive features in this edition over previous issues.

One is the division of Microscopes and accessories, Microtomes and accessories, and apparatus for Photo-Micrography, and Bacteriological and Laboratory supplies, each article being distinctively enumerated under their respective headings. There is embodied in this edition as complete a line of apparatus as is needed for general Microscopical work, both for the individual as well as for laboratory purposes, so that the catalogue is a handy reference book for the intending purchaser.

We note the fact that the spiral rack and pinion is used only for the coarse adjustment, and that they are cut with specially devised automatic machinery.

Among new instruments we notice the W Laboratory Dissecting microscope which is designed for use in laboratories. There are some changes in the construction of Microtomes; the object holder with its various adjustments is made considerably heavier; its vertical adjustment on the slide is made to act without disturbing the relation of the specimen to the knife and the inclination of the object in either direction by universal joint; the method of feeding the screw has been changed to remove the possibility of making failures; permanent lever which is provided with a reversible pawl acts in either direction on the milled edge of the disk and works within a definite limit which is prescribed by two set screws attached to the arc of a fixed circle.

The list of Bacteriological apparatus, Water-baths and ovens, has been considerably increased. In the line of glass-ware, they have increased their stock of such articles as are most needed for Bacteriological Laboratories. A pocket set of dissecting instruments in leather case is considered very unique and will meet with a great deal of favor on account of its neatness and practicability.

There will be found a number of testimonials from well-known scientists who have used the Continental and American type of microscopes and objectives.

Another new feature is an article on Microtome knives and their care, which we consider very important, as it gives considerable information on the subject, valuable to the user of microtome knives. They also include aside from the microtome knives a series of section razors, hones and strops.

MICROSCOPICAL MANIPULATION.

Examination of Rocks—The identification of the crystalline constituents of Eruptive Rocks by their optical behavior when in thin sections under the microscope, is extremely simple. Each mineral, in virtue of its structure and composition, possesses characteristic optical properties by which it may be recognized.

By transmitted light they appear either colorless, colored or opaque. The colored minerals may next be examined with the polarizer only, when some will pass from light to dark tints as the prism is rotated (pleochroic), while others will remain unaffected (non-dichroic). If the analyzer be now added, those minerals which depolarize will give more or less brilliant chromatic effects as the polarizer is rotated (anisotropic), while others will show no color changes, merely remaining dark between crossed Nicols (isotropic). The commonest colorless sections are those of quartz, feldspars, leucite, nepheline, enstatite, olivine, apatite; and these are all anisotropic save leucite, which is dark between crossed prisms, and apatite, which usually continues bright. Muscovite, biotite, hornblende and ferruginous enstatite are dichroic and anisotropic, while augite and diallage are non-dichroic but anisotropic, and all are colored by transmitted light. Magnetite and pyrites are both opaque, but, viewed by reflected light, the former is of a leaden and the latter of a brassy hue.

The most abundant alteration products are chlorites, serpentine, calcite and opaque iron ores. The two former are green, only the first is pleochroic; calcite is colorless, traversed by fine cleavage lines intersecting at an acute angle, and giving iridescent polarization.

MEDICAL MICROSCOPY.

Thirty Years Ago.—It is only a quarter of a century since the microscope came to be of consequence to the physician. Now a man is utterly unfit to practice medicine without one. In tuberculosis, heart disease, la grippe, and influenza, the ba-

cillus which causes the trouble can be detected in the sputum. We now know that dysentery and cholera are due to microscopic organisms. The condition of the blood is quickly revealed under the objective. Whole books have been written on this subject, the latest of which is Wethered's Medical Microscopy and which no physician can do without unless he has Beale or some other of the earlier treatises.

Thirty Years Hence.—It will not surprise us if within 30 years the number of housekeepers who use microscopes equals the number of doctors who now use them. Housewives could detect a great number of adulterations in groceries and drugs. They could examine meat and so reject that which contains trichinae, tuberculosis and other fatal disease germs. A multitude of sicknesses could thus be warded off. In Berlin, and other parts of Germany, already all animals slaughtered are inspected microscopically. In Berlin, 45 ladies, trained for this special work, are constantly employed. Blood, tissues, etc., are scrutinized. There is a heavy penalty for selling uninspected meat.

Naval Medical School.—Among the required studies at our Naval laboratory in New York, the Secretary of the Navy prescribes the following:

Microscopy and Microbiology: Practical acquaintance with the handling of the microscope, its construction, use, care, and choice; simple lens, optical principle, construction, and use; compound lens, low-power objectives, use and care; accessory apparatus, general method of work, illumination, effect of different media: the eyes, peculiarities, use, and protection; mounting, dry, in liquid, and in cells; section cutting soft and hard tissues, crystals, rock sections and grains; staining; high power objectives, use and care, cover connections, and immersion fluids; adulteration of foods, drugs, etc., detection of fibers, paper, and handwriting.

Microbiology.—Laboratory examination of unicellular forms of life, yeasts, protococcus, amœba, the molds, algae, and fungi of fresh waters; fauna of potable waters.

General Bacteriology.—Isolation, preparation of culture media, mounting and study and identification of species, bacteria of potable waters, sewage bacteria, typhoid bacillus, biological ex-

amination of Croton water. Brooklyn aqueduct water, etc., bacteria of the atmosphere, biological analysis of air of hospital wards, class rooms, etc., disinfectants and filters, bacteriological tests.

BIOLOGICAL NOTES.

How the Rabbit-Plague Came.—In the early settlement of Australia game was plentiful. Kangaroos of many sizes and colors roamed the island-continent. But the game seen in Great Britain was not met there. The English colonists desired some familiar animals. A settler ordered a box of rabbits from England. Three pairs were brought, liberated in the thickets, and admonished to multiply and replenish the earth. On a continent of 2,900,000 square miles they had plenty of room for exercise, enjoyed unrestricted liberty for travel, and were but seldom seen. So rarely were they visible that they were regarded as curiosities and relics of animal life in the old country. The colonists wished the rabbits to become more common, and did not molest them. Their only enemies were the wild dingoes, the foxes, and other carnivorous creatures.

The animals made a start in the world, and, notwithstanding their losses by wild dogs and other flesh-eating quadrupeds, began to increase. Their powers of reproduction are well known, and in a few years they began to be observed in various districts. Their numbers made them the object of sport; guns were levelled at them and dogs were imported and set in motion behind them, but they had come to stay and could not be repressed.

Blood Coagulation.—Miss Claypole says: From the action of different per cent solutions of the neutral salts $MgSO_4$ and Na_2SO_4 in relation to coagulation, an essentially different condition is found to exist in amphibian and fish blood from that known to be present in mammalian blood. True fibrin forms in the presence of neutral salts in solutions above 5 per cent. The rapidity of formation increases with the strength of the solutions, beginning in 6 per cent in six hours and appearing in 15, 20, and 25 per cent in thirty to forty minutes. The quantity also varies; in amphibia it increases toward 7 per cent solution as a maximum; afterward a decrease in quantity is ap-

parent. In the blood of *Amia calva* a slightly different condition is present. Simultaneously with the formation of this true fibrin an additional formation takes place. This is of a jelly-like nature and has been called the additional fibrin. This fibrin increases uniformly with the increased strength of the salt solutions. George Semmer has investigated a similar formation in the blood of the frog and domestic fowl under slightly different conditions. He considers that the additional fibrin is produced from the protoplasm of the red cells of the blood by the solvent action of the neutral salts. This additional fibrin is not formed in the blood of mammals, but occurs in that of birds, amphibia (*Cryptobranchus*, *Necturus*, *Rana*), and of a ganoid (*Amia*). This distinction perhaps makes it possible to draw a stronger line between the nucleated and non-nucleated corpuscle-bearing animals. The experiments should be extended to the large field of work offered among the Teleosts and other forms of fishes, and also to reptiles, in order to make a sure generalization on this point.

Blood Corpuscles.—The conclusions of Miss Claypole are as follows: From the measurement and counting of the corpuscles in *Necturus* and *Cryptobranchus* the following facts were ascertained: The cells of *Necturus* are much larger than those of *Cryptobranchus*. Comparing this result with the measurements given by different authors of the corpuscles in other forms of amphibia, a distinction can be made on the basis of size of cells between those animals possessing external gills and those without; to which rule, however, a striking exception is found in *Amphiuma*. In enumeration, also, a difference is shown to exist between the large and small corpuscle-bearing animals, the higher numbers of corpuscles per cubic millimeter belonging to the latter class of animals.

From experiments made on *Necturus* and *Cryptobranchus* in the injection of small quantities of carbon into the abdominal cavity, hypodermically, the following results were obtained: In the first place, it was established that under the given conditions the leucocytes ingested all the foreign material and entered the blood circulation after varying periods. In the second place, it was found that from the blood the ingested cells are distributed to the tissues and ultimately pass away on mucous and epidermic surfaces with waste products of the body.

Thirdly, that no deposit of free material takes place, the foreign substance being contained exclusively in leucocytes, with the one exception of the splenic cells, where carbon is present. This latter position is a secondary result. From the above it is concluded that probably the fate of many leucocytes is to wander out on mucous and epidermic surfaces and to pass away with waste products. Many must also meet their end in splenic cells, as is shown by the considerable amount of carbon present there. The fate of this carbon is left undetermined from want of time to pursue the investigation further.

To Color Oranges Red.—An ingenious rascal has found out how to make "blood" oranges. They sell better by coloring the rind; it is not necessary to color the pulp. A microscopical examination of some taken in the market showed in a section of the epicarp the presence of a coloring matter with a violet tinge localized in the glands and not passing beyond the cuticle. At certain points, where it had accumulated near the glands, the color was dark red. The coloring matter used is said to be scarlet of Biebrich (Rocelline), which is a nitro derivative of amidouzobenzol, obtained by adding diazobenzol to an acid solution of b-naphthol. It is applied in aqueous solution and is not poisonous.

Composition of Mule's Milk.—Prof. A. B. Aubert reports as follows: After being kept eight days no curdling took place, but simply the separation of a very fine flocculent floating coagulum. The fat globules generally proved rather small; approximately 10 per cent. averaging 0.001 mm., in diameter, 40 per cent. from 0.0018 to 0.0037 mm., 40 per cent. varied from 0.0037 to 0.0092 mm., the remainder running from 0.0092 to 0.0222 mm. and over. The quantity of albumen was found to be very small, not over 0.5 per cent. The results of analysis are published in the Journal of Chemistry for June, 1893.

MICROSCOPICAL SOCIETIES.

Quekett Club, London.

October 20, 1893.—Swift & Son exhibited their new biological microscopes with tripod stand of the Powell & Lealand pattern.

In the horizontal position, the limb of the instrument rests squarely on the posterior foot of the tripod, thus insuring great steadiness. The fine adjustment is compensated to take up any wear in the micrometer screw or its bearings. In the simpler form there is an understage jacket to take any illuminating apparatus; but a centering and rack-work substage can be fitted at any time without having to return the instrument to the makers as all parts and holes for screws are made to accurate gauge.

A stand by Leitz, of Wetzlar, was shown by Mr. Curties. It is the first German microscope made on an English model. The foot is of the bent-claw pattern. It has the Nelson horse shoe stage with sliding-bar. The fine adjustment and fitting for condenser follow the Zeiss model.

T. F. Smith gave a demonstration of the effect of orthochromatic plates in the corrections of the objective, and his views on the structure of the valve of *Pleurosigma angulatum*, illustrated by photographs and oxy-hydrogen lantern.

Lincoln Microscope Club, Lincoln, Neb.

October 31st.—Dr. Ward, Associate Professor of Zoology in the University of Nebraska was recommended for membership by the executive committee. Prof. Bessey showed a Ryder automatic microtome, explaining its merits and what he considered its defects. Mr. Pound spoke briefly of the transactions of the San Francisco Microscopical Society.

Among the slides exhibited was a fish parasite, *Distomum nodulosum*, shown by Dr. Ward. This species, not reported from this country, was found in abundance in Lake Michigan this summer.

November 28.—Dr. Bessey spoke briefly of the Reinhold-Giltay microtome and also of Zimmermann's Botanical Microtechnique (translated by Humphrey). Mr. Dales spoke of his work in collar correcting a 1-20 immersion objective made for a 10 inch tube for an 8 inch tube.

Among the interesting slides exhibited, was a lung parasite found in the lung of a cat at Ann Arbor, Michigan, by Dr. Ward, which he believed to be identical with the Asiatic lung parasite—*Distomum westermanni*.

Titles of Microscopical Publications.— XI.

NOTE.—Cut up this leaf, pasting each item on the upper part of a card, 5x2 inches. When a publication cited is in your library, paste your own label or some distinctive paper on the lower (unused) part of its card. You will then keep catalogue-cards of uniform thickness, which you can assort nicely into alphabetical packages. The other cards, which to you are merely bibliographical, can, if desired, be balanced on the lower half with paper of a different color from that used in your catalogue-cards. Not only microscopical books but pamphlets and the most important magazine articles should be included herein. Send to us for publication any other titles that you can collect in your library, so as to complete a printed catalogue for yourself and a bibliography for all.

Vuillemin, Paul: *La Biologie Végétale.* 12mo., pp., 380; 82 illustrations. J. B. Baillière et Fils. Paris: 1888.

Couvreur, E.: *Le Microscope et ses Applications à l'étude des Végétaux et des animaux.* 12mo., pp., 350; 112 illustrations. J. B. Baillière et Fils. Paris: 1888.

Fabre-Domergue: *Premiers Principes du Microscope et de la technique microscopique.* 12mo., pp., IV., 280; 32 illustrations. Asselin et Houzeau. Paris: 1889.

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Wolle, Francis: *Desmids of the United States.* 2d ed. 8vo. Bethlehem, Pa.: 1892.

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Woodward, J. J.: *On the Structure of Podura Scale, and other Test-objects (Diatoms).* 8vo. pp., 14. Mo. Micro. Jour. London: 1871.

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